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ADAPTATION TO CLIMATE CHANGE

Concrete solutions for our greatest challenges

Mission Solutions Explorer

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Legend

Climate hazards

- Coastal erosion
- Drought
- Extreme heat
- Flooding
- Heavy precipitation
- Landslide
- Precipitation changes
- Sea-level rise
- Severe winds
- Storms
- Surface air temperature
- Tropical cyclones
- Wildfires

Main themes

- Adaptation funding and finance
- Behavioural change
- Ecosystems and nature-based solutions
- Governance
- Health and well-being
- Infrastructure
- Knowledge and data on adaptation
- Land use and food system
- Local economic systems
- Mainstreaming adaptation
- Stakeholder and citizen engagement
- Transformative change
- Water management

Foreword



Climate change is no longer a distant challenge. Across Europe, regions and communities are already experiencing more frequent floods, droughts, heatwaves, wildfires and coastal erosion. Yet, they are also demonstrating that adaptation is possible. Every day, regional and local authorities, researchers, businesses, civil-society organisations and EU-funded projects are developing innovative solutions that make communities safer, stronger and more resilient.

This *Mission Solutions Explorer* brings together 100 examples from across the EU Mission on Adaptation to Climate Change. Behind every factsheet lies a real experience: a challenge identified, a partnership built, a solution tested and a valuable lesson learned. Some initiatives are large, others more modest. Some rely on nature, others on technology, governance or finance. Together, they show that there is no single pathway to climate resilience, but rather a growing portfolio of practical solutions that can inspire action in territories facing similar climate hazards.

The Solutions Explorer has one simple ambition: to help others move from inspiration to implementation. It is not a technical manual or a comprehensive inventory of adaptation measures. Instead, it offers accessible examples that regions, cities and communities can adapt to their own circumstances. Each factsheet highlights not only the solution itself, but also its co-benefits, funding opportunities, key stakeholders and lessons for replication.

This publication is also an important milestone in a much broader journey. From October 2026, it will become part of the European Integrated Framework for Climate Resilience, alongside the Climate Viewer and the Navigator of Tools. Together, these resources will help decision-makers better understand climate risks, identify suitable adaptation measures and access the knowledge and tools needed to strengthen resilience across Europe.

Most importantly, this resource is only the beginning. It is designed as a living resource that will continue to grow as new solutions emerge, projects deliver results and regions share their experiences. The solutions presented here are also available through the Mission Portal, where users can explore them in an interactive, searchable database, browse by climate hazard, sector or location, and discover experiences most relevant to their own context. New solutions will be added regularly, ensuring that the catalogue continues to reflect the latest knowledge and practices emerging from the Mission community.

My sincere thanks go to the entire Mission community – our Charter Signatories, Mission projects, researchers, public authorities, practitioners and countless partners – whose commitment, creativity and determination have made this publication possible. Their work demonstrates that climate adaptation is already happening across Europe, and that by learning from one another we can accelerate our collective journey towards a more resilient future.



Elina Bardram
Mission Manager, EU Mission on Adaptation to Climate Change

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Ecosystems and nature-based solutions

Nature-based solutions | Building protocols | Sustainable tourism

Adapting Alpine buildings and tourism to warmer temperatures

Combining new services, data-driven innovation and a sustainable tourism transition

Climate hazards

Main themes

The Tyrol, Austria

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Key figures

12%
of the area suitable for permanent settlements

EUR 2 billion
of economic impact from climate change in Austria

Implementation timeline

5 years
The MountResilience project spans from 2023 to 2028

Solutions [1][2]

MountResilience MountResilience aims at at helping mountain communities build resilience to the impacts of climate change. The project works across several alpine and mountainous regions to develop, test and scale practical adaptation and nature-based solutions tailored to local needs. It also aims to encourage behaviour change among citizens so they can better respond to climate challenges specific to mountain environments. The solutions put forward in the Austrian Tyrol region through this project are as follows.

1. **Transition to sustainable tourism.** Collaborating with cable car companies and tourism associations to develop resilient future pathways for ski regions and promote tourism models that are less dependent on snow.
2. **Heat resilience in buildings.** Using digital twin technology to simulate future climate scenarios for buildings and public spaces, enabling the virtual testing of adaptation measures (e.g. green infrastructure) to support informed decision-making.
3. **Data-driven innovation for adaptation.** Working with data providers and end users to develop innovative tools and close critical data gaps, enabling municipalities and businesses to make more informed climate adaptation decisions.

[1] MountResilience, 'Tirol, Austria', MountResilience website, https://mountresilience.eu/region/tirol-austria/.

[2] European Commission: Directorate-General for Climate Action, 'Adapting Alpine buildings and tourism to warmer temperatures', 30 June 2026, https://mountresilience.eu/wp-content/uploads/2026/06/Tyrol-leaflet-DIGITAL.pdf.

Co-benefits

Economic

In the Tyrol, where rural areas depend strongly on winter seasonal tourism income, climate change places growing pressure on local economies by increasing costs and disrupting business models tied to natural resources and stable climatic conditions. MountResilience aims at addressing this by supporting the transition towards a year-round tourism model less dependent on snow, which could reduce the significant water and energy costs associated with artificial snow production at lower-altitude areas. Additionally, adaptation measures help to safeguard productivity by reducing heat-related impacts on workers and buildings, improving preparedness for climate-related disruptions and enabling municipalities and businesses to make informed, forward-looking investment decisions that reduce future costs.

Social

MountResilience strengthens the resilience and well-being of Tyrol's communities by improving preparedness and adaptive capacity among municipalities and businesses. Through adaptation measures for buildings and public spaces, the project helps protect vulnerable groups, such as children, older people or people with pre-existing health conditions, from increasing heat stress and improves living and working conditions. It tests its pilot approach by adapting a nursing home to better cope with extreme summer heat, thereby helping to protect community well-being. At the same time, stakeholder engagement and data-driven decisions foster awareness, collaboration and informed action while supporting the transition towards more resilient tourism models in an open dialogue with ski resorts, cable car companies and local partners. Finally, transitioning to a less snow-dependent, year-round tourism model could contribute to stabler livelihoods and social stability in Alpine regions.

Environmental

MountResilience contributes to the protection of the Tyrol's natural environment through nature-based solutions. By transitioning away from artificial snow production, which consumes significant water and energy and risks maladaptation, the project reduces pressure on local natural resources. Building-level measures such as green roofs, white roofs and green façades provide nature-based cooling and contribute to urban greening. Improved insulation and energy-efficient ventilation systems lower energy consumption in buildings, thus contributing to a more sustainable use of natural resources and long-term climate resilience across the region.

Replicability – *Who can use this approach and how*

Replicating the Tyrol approach

How other mountainous regions can adopt digital twin modelling, nature-based building solutions and a collaborative tourism transition to build climate resilience

Best suited for

Mountainous regions and communities across Europe would be the most interested in replicating the MountResilience approach, given that the project was specifically designed to support replication in these specific areas facing comparable climate challenges. With the project already implemented across six diverse mountain regions, these areas share similar vulnerabilities, including warming temperatures, reduced snowfall and pressure on economies dependent on natural resources and winter seasonal tourism. It would also be straightforward to replicate this for mountain regions beyond those involved in the project.

Stakeholders' role

The development of MountResilience solutions in the Tyrol involved a diverse group of stakeholders. MountResilience partners collaborated with Universität Innsbruck for research and digital twin modelling, with Standortagentur Tirol as regional demonstrator, and two specialised local agencies, Klimabündnis Tirol and Energieagentur Tirol, to support building adaptation and energy efficiency measures. On the practitioner side, a nursing home served as the direct beneficiary for heat resilience testing, while ski resorts and cable car companies partnered on the transition to sustainable year-round tourism. To replicate

these solutions elsewhere, a similar combination of stakeholders would be essential: research institutions for simulation and foresight capabilities, regional development agencies to facilitate coordination, climate and energy organisations to implement building-level measures, and local tourism operators to drive the shift away from snow-dependent models.

Built-in scalable tools

The key replicable elements centre on the application of digital twin technology, which allows for the simulation of future climate scenarios and the virtual testing of adaptation measures such as green and white roofs, green façades, improved insulation and energy-efficient ventilation systems. Beyond the technology itself, the methodology of using simulations and foresight to guide adaptation offers a transferable framework for other mountainous areas. This is complemented by a collaborative process involving direct engagement with stakeholders, including ski resorts and cable car companies, to facilitate dialogue on transitioning towards sustainable, less snow-dependent tourism models. The overarching lesson for replication is that adaptation is most effective when technological solutions are considered together with the social and economic realities of the region.

Funding pathways

The MountResilience project is funded through Horizon Europe under grant agreement number 101112876.

CORDIS EU

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Ecosystems and nature-based solutions

Urban heat adaptation | Nature-based solutions | Equitable access | Green infrastructure | Climate resilience

Antwerp's cool spots: local solutions to urban heat

Nature-based cooling hubs – equitable, data-driven heat resilience for dense cities

Climate hazards:

Main themes:

Antwerp, Belgium

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Key figures

+ 2 °C
average urban heat island effect, up to **+ 9° C**

150 m
maximum walking distance from every residence to cool spots

200 m²
unpaved and greened for each cool spot

Implementation timeline

2019–ongoing

Solutions

Building on a thematic study on heat stress at the city level, Antwerp developed its climate plan, which encompasses the following.

1. **Identification of heat stress areas.**
These areas have been identified through scientific indicators such as the wet-bulb globe temperature, measuring humidity, sunlight, wind and the cooling effect of shade, vegetation and water to assess people's feeling of heat, or the potential average radiation temperature, to measure the heat emitted from surfaces and areas within the city.

2. **Cool spots programme.**
The programme is a short-term solution aiming to create small, accessible, shaded refuge zones designed to counteract extreme heat. Each spot meets strict criteria: a minimum size of **200 square metres**; **80 %** of the surface must be under tree canopy cover; and **50 %** of the surface must be unpaved and vegetated. Each spot must incorporate seating, drinking water and cooling features like misting or fountains, and be within **150 metres**, walking distance from every residence.

3. **Garden streets.**
Streets that have too much pavement have been transformed into green corridors. These streets provide shade, reduce heat and help absorb rainwater. The initiatives are organised by the city together with residents, who actively participate in planning and implementing the changes.

4. **Future trees.**
Monumental trees have been planted with special underground systems to provide them with space, water and nutrients.

5. **Private greening incentives.**
There are municipal incentives for private entities, schools and citizens to add more greenery and to de-pave, with technical support also being offered to do so.



Co-benefits

Economic

Antwerp's cool spots can generate economic benefits by reducing heat-related health costs and productivity losses during heatwaves. In addition, Antwerp's forward-looking climate plan helps the city enhance its attractiveness by ensuring a healthy, pleasant and resilient living environment.

Social

Antwerp's cool spots enhance social resilience by prioritising vulnerable groups, such as older people and low-income communities, through targeted placement in high-risk areas. The initiative boosts urban liveability by offering shaded seating, drinking water and cooling features like misting, creating comfortable public spaces even during extreme heat. Accessibility is central, with every residence guaranteed a cool spot within 150 metres, ensuring equitable protection from heat, while redefining urban space usage for community well-being.

Environmental

Antwerp's cool spots deliver multiple environmental co-benefits by integrating nature-based cooling solutions into urban design. The initiative directly counters the urban heat island effect. The selected tree species and green areas boost biodiversity, creating ecologically interconnected habitats within the city. Additionally, water-retentive infrastructure supports healthy tree growth while improving stormwater management through permeable surfaces. These green interventions further enhance air quality by filtering pollutants, making urban areas healthier and more sustainable.



Replicability – *Who can use this approach and how*

Replicating Antwerp's cool spots – a model for heat-resilient cities

How cross-sector partnerships, citizen co-design and smart monitoring can scale up cooling solutions

Best suited for

Antwerp's approach is highly replicable because it combines clear spatial standards, simple nature-based interventions and a strong governance framework that can be adapted to different urban contexts without requiring complex technological systems. It is particularly well suited to densely built European cities experiencing increasing heat stress, with limited availability of green spaces and growing public health concerns linked to extreme temperatures.

Stakeholders' role

Replication relies on a multistakeholder governance model led by municipalities, supported by coordination across urban planning, environment and public health departments. Citizens contribute through co-design and local ownership, knowledge partners provide data and impact assessments, and private stakeholders support implementation and maintenance, making the model collaborative and scalable.

Built-in scalable tools

Scaling up is enabled through practical tools such as heat and climate dashboards for identifying priority areas, standardised design criteria that can be reused across sites, and participatory platforms that structure citizen engagement. These elements allow cities to replicate the model incrementally, starting with pilot areas and expanding based on performance and demand.

Funding pathways

The financing structure supports transferability by combining municipal investment with EU and regional funding, complemented by public–private partnerships and, in some cases, participatory funding mechanisms. This blended approach makes the model feasible across cities with different administrative and financial capacities.

GreenPlan Antwerp • Heat mapping case study • Mission story • EU Covenant of Mayors • Business in Antwerp

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Ecosystems and nature-based solutions

Nature-based solutions | Sustainable farming | Landscape approach

Scaling nature-based solutions for climate resilience: Nbracer approach

Replicating co-designed adaptation measures from East Flanders

Climate hazards:

Main themes:

East Flanders, Belgium

Contact: Nbracer project coordinator, Stichting Deltares, Netherlands

Key figures

298 200 ha
regional extension area

1 491 ha
of natural wetlands present in the area

Implementation timeline

Four years
The Nbracer project spans from 2023 to 2027

Solutions ([1]) ([2])

The Nbracer (Nature-based solutions for Atlantic regional climate resilience) project is a Horizon-Europe-funded initiative supporting the EU Mission on Adaptation to Climate Change, focusing on the co-design and implementation of nature-based solutions (NBS) across marine and coastal, urban and rural landscapes in the European Atlantic biogeographical area. In East Flanders, Belgium, the project collects insights and experiences from different pilot areas managed by the Flanders Environment Agency and including the South-Western Flemish Ardennes, the Moervaart Valley and the Water+Land+Schap project. This regional approach gathers knowledge on practical NBS application for climate adaptation, while considering the socioeconomic context and strengthening ecosystem services. The solutions put forward in this project are as follows.

1. **Land development and spatial planning.** Drawing on the land development plan in the South-Western Flemish Ardennes, to provide a model for replication by identifying scalable NBS interventions aligned with unique environmental conditions and socioeconomic factors.
2. **Natural wetlands.** Building on experiences from the Moervaart Valley project, including the Maaibos wetland restoration case study, to improve water retention, flood prevention and ecosystem restoration.

([1]) Nbracer, 'Replicating Region – East Flanders', Nbracer website, https://nbracer.eu/regions/east-flanders/.
([2]) Luijendijk, A., Bucx, T. and Jovanovic, O., 'Co-design of transformative systemic solutions in marine and coastal landscape systems', Deltares, 2025, https://www.kenniswest.be/publicatie/co-design-of-transformative-systemic-solutions-in-marine-and-coastal-landscape-systems-natuurgebaseerde-klimaatoplossingen-in/298166.

3. **Afforestation. Implementation**
Implementing tree planting measures to enhance biodiversity, support ecosystem services and contribute to regional climate adaptation objectives.

4. **Soil management.**
Replicating practices demonstrated in West Flanders polders, where non-tillage and carbon farming are tested to restore natural soil systems, improve water retention and enhance climate resilience. As noted in the project, a regional translation of data and knowledge is planned for replicator areas to assess outscaling potential.

5. **Natural weirs and recovery of natural banks.**
Nature-based interventions to manage rivers at the landscape level.

Co-benefits (2)

Economic

The proposed solutions could offer several economic co-benefits, particularly in the area of sustainable farming practices. Non-inversion tillage leads to lower fuel costs and time savings for farmers, while carbon farming improves overall soil quality, resulting in higher yields and reduced nutrient and water demands. Combining sustainable agricultural practices such as carbon farming, organic manure, non-inversion tillage and agroforestry can bring multiple benefits for investment. Sharing systems for agricultural machines could help de-risk individual transition investments while creating new markets. Additionally, consumers or governments may be willing to pay for carbon sequestration through a carbon credit market system, offering a potential revenue stream for farmers.

Social

The proposed solutions aim at achieving several social co-benefits that contribute to community well-being and resilience. Non-inversion tillage and carbon farming provide enhanced food security through more climate-resilient agricultural practices. Water management solutions deliver reduced flooding risk for private houses and roads, protecting residential areas, along with heat reduction through cooling spots that improve public health outcomes. Restored natural areas and wetlands contribute recreational benefits and an enhanced sense of place, while land development and spatial planning strengthen local resilience through tailored interventions that align with community values. Additionally, participatory co-design processes foster stakeholder engagement and collaboration across regions. Finally, biodiversity restoration supports local ecological identity and protects tourism and recreational resources.

Environmental

The proposed solutions would deliver multiple environmental co-benefits that enhance regional ecological health and climate resilience. Non-inversion tillage and carbon farming improve soil quality by increasing water infiltration and retention, enhancing soil biodiversity and sequestering carbon in the soil, thereby contributing to climate mitigation while protecting against erosion through increased crop residue cover. Natural wetlands improve water retention across interconnected landscapes, prevent flooding, restore ecosystems and natural habitats, enhance water quality and support biodiversity and protected species. Land development and spatial planning interventions strengthen ecosystem services provision, improve water management systems and enhance biodiversity through tailored NBS. Additionally, natural weirs and the recovery of natural banks improve water flow dynamics and support natural habitat recovery, while afforestation contributes to climate adaptation objectives. Collectively, these measures aim at creating more natural and healthier soil systems, supporting native species and strengthening overall regional ecosystem services.

Replicability – *Who can use this approach and how*

Replicating nature-based solutions from East Flanders

Built-in elements for transferring climate resilience practices across regions and landscapes

Best suited for

Based on the sources, the proposed solutions can be replicated in regions with similar geographic and landscape characteristics, particularly flat coastal areas and low-lying zones where water management is a key priority. Estuarine systems and rural agricultural landscapes are also well suited for replication. The project primarily focuses on the European Atlantic biogeographical region, though the general approach may be transferable to other areas facing comparable climate risks and environmental conditions.

Stakeholders' role

The replication of the proposed solutions in East Flanders and beyond relies on a multi-actor approach. The Flanders Environment Agency is positioned as the central actor, gathering knowledge on practical NBS application and facilitating replication of land development projects from the South-Western Flemish Ardennes. Provincial and municipal governments hold decision-making authority over territory management, permits and water management, making them essential for enabling implementation. Research and knowledge partners provide scientific evidence and technical assessments to inform replication, while water managers and authorities are critical for solutions involving water level agreements and hydrographic management. Farmers are key implementers for soil management practices, while nature organisations represent biodiversity and ecosystem interests. Successful replication requires collaboration across governance, knowledge and implementation levels, supported by standardised protocols for stakeholder identification and engagement activities.

Built-in scalable tools

The East Flanders solutions can be replicated by leveraging the standardised five-step co-design process, which structures stakeholder engagement and decision-making for tailored NBS. Technical components, including ecosystem service mapping methods and climate risk assessment protocols for floods and droughts, provide evidence-based foundations for designing interventions like wetland restoration or afforestation. Monitoring frameworks with specific key performance indicators for soil quality, water retention and biodiversity enable a consistent evaluation of outcomes, in addition to documentation tools to capture governance structures and lessons learned on barriers. Both the technical components and the monitoring frameworks can be easily replicated in other regions.

Funding pathways [3]

The Nbracer project is funded through Horizon Europe grant agreement number 101112836.

[3] European Commission, 'Nature Based Solutions for Atlantic Regional Climate Resilience', European Commission website, https://cordis.europa.eu/project/id/101112836.

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Ecosystems and nature-based solutions

Nature-based solutions | Urban greening | Early-warning systems

Building climate resilience in mountainous communities: Gabrovo's approach

Adapting through green infrastructure and early warning systems in the MountResilience project

Climate hazards:

Main themes:

Gabrovo, Bulgaria

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Key figures

50 %
of Gabrovo's territory covered with forests

1/3
of forests included in Nature 2000

Implementation timeline

5 years
The MountResilience project spans from 2023 to 2028

Solutions

The MountResilience project works with regions and communities in mountainous areas, helping them with some EU funding to strengthen their ability to respond to climate change and improve resilience. Gabrovo, Bulgaria, is a mountainous city located on the terraces of five rivers at the foot of the Balkan Mountain range in northern Central Bulgaria. Over 50 % of Gabrovo's territory is covered with forests, one third of which are included in the Natura 2000 network. This landscape of forests, rivers, and proximity to the Balkan Mountains creates local microclimates that increase the municipality's exposure to climate change. Rising temperatures, longer droughts, humid winters and more extreme weather are worsening heat stress, air quality and the risks of forest fires and floods. The urban heat island effect is growing, affecting health and quality of life for the many residents living in urban areas. The solutions put forward through this project are as follows.

1. **Green infrastructure strategy.**
The project mapped Gabrovo's urban green and blue infrastructure and is co-designing a new strategy with municipal departments, citizens, experts and local stakeholders through participatory workshops, surveys and informal community events. A pilot rainwater harvesting system will collect rainwater from the roof of the city theatre to irrigate green spaces in the city centre, complemented by tree planting and increased permeable surfaces to reduce run-off, cool the city and support efficient water management.

2. **Early warning and monitoring system.**
A digital monitoring system equipped with sensors, a thermal camera, a drone and artificial intelligence data analysis models will enable real-time observation of potential threats related to floods, forest fires and hurricanes. This system supports municipal decision-making and provides citizens with timely alerts to improve preparedness and response capacity throughout the city.



Co-benefits

Economic

Several proposed solutions could generate economic co-benefits. Rainwater harvesting for irrigating urban green spaces may reduce municipal water costs, while increased permeable surfaces and tree planting aimed at reducing run-off could help reduce flood-related damages. The early warning and monitoring system for floods, forest fires and strong winds could minimise economic losses from natural hazards by enabling faster, more targeted responses. Additionally, cooling the city and mitigating the urban heat island effect could decrease energy demand for cooling and reduce heat-related healthcare costs.

Social

Several social co-benefits are associated with the project interventions. By reducing the urban heat island effect through green infrastructure interventions, the project aims to improve residents' health and overall quality of life. Public awareness and education are strengthened through participatory workshops, surveys and community events, which raise understanding of climate change and health risks. Early stakeholder engagement has helped build trust and support for the green infrastructure strategy. The early warning and monitoring system enhances community safety by providing timely information and alerts on floods, forest fires and strong winds, improving citizen preparedness and response capacity. Additionally, the project seeks to influence citizens' behaviour to more effectively address specific climate impacts, thereby empowering residents and strengthening collective resilience to climate-related challenges.

Environmental

The MountResilience project delivers environmental co-benefits by promoting the sustainable use of natural resources through innovative nature-based solutions. A central measure involves rainwater harvesting, which collects water from building roofs to irrigate urban green spaces, supporting efficient water management and keeping these areas healthy under changing climate conditions. The addition of permeable surfaces and tree planting reduces surface run-off and contributes to cooling the city. In addition, nature-based solutions and urban greening can support biodiversity enhancement, which is particularly relevant given that one third of Gabrovo's forests are included in the Natura 2000 network.

Replicability – *Who can use this approach and how*

Scaling up climate resilience in mountainous regions

Replicating nature-based solutions and early warning systems from Gabrovo

Best suited for

MountResilience's approach is best suited for replication by European regions and communities located in mountainous areas, particularly municipal authorities facing similar climate risks such as extreme heat, flooding, wildfires and severe winds. Other municipalities in comparable geographic settings across Europe seeking to transition toward a climate-resilient society and manage exposure to local microclimates would be best positioned to adopt these solutions.

Stakeholders' role

Successful replication of the MountResilience solutions requires the engagement of municipal departments, citizens, experts and local stakeholders, mirroring the participatory approach used in Gabrovo. Municipal departments lead the development of strategies in cooperation with these groups through workshops, surveys and co-creation sessions. Experts provide technical input on design details such as irrigation systems and monitoring technologies, while citizens contribute feedback through questionnaires and informal events. Engaging these stakeholders early is essential, as the Gabrovo experience demonstrates that such collaboration builds trust and support for the adaptation strategies and their implementation.

Built-in scalable tools

The MountResilience project incorporates several replicable elements designed for transfer to other European mountainous regions. The green infrastructure strategy framework can be replicated because it relies on a structured methodology combining infrastructure mapping with participatory co-design through workshops, surveys and community events, which can be adapted to different local contexts. The rainwater harvesting pilot system is replicable as a modular physical intervention that uses readily available technology to collect water from building roofs for irrigating urban green spaces, reducing dependence on external water supplies. Similarly, tree planting and increased permeable surfaces are low-tech, adaptable measures that can be scaled across varying urban settings. The early-warning and monitoring system is designed for replication as it employs standard digital tools that can be configured to monitor site-specific hazards such as floods, forest fires and strong winds. Overall, the project explicitly aims to scale up these climate adaptation and nature-based solutions, indicating that their design prioritises transferability across diverse mountainous communities facing comparable climate risks.

Funding pathways

The MountResilience project is funded through Horizon Europe under grant agreement number 101112876.

Gabrovo, Bulgaria · MountResilience · Gabrovo-leaflet-DIGITAL.pdf · CORDIS EU

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Ecosystems and nature-based solutions

Innovative | Scalable | Multifunctional

Nicosia's gardens of the future: a holistic approach to water management

Scalable, multifunctional interventions for water-efficient cities

Climate hazards:

Main themes:

Location
Nicosia, Cyprus

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

3
interconnected nature-based demonstration projects forming an integrated framework

Implementation timeline

2023–2028
Cardimed project timeline

Solutions

The Nicosia future gardens demonstration site, part of the climate adaptation and resilience demonstrated in the Mediterranean region (Cardimed) project funded under the EU Mission on Adaptation to Climate Change, showcases how nature-based solutions and innovative technologies can restore degraded ecosystems, enhance biodiversity and promote circular economy principles in urban and peri-urban areas. Through three pilot interventions, the project integrates water treatment, soil remediation and sustainable urban agriculture while delivering climate resilience, water efficiency and socioeconomic co-benefits.

1. **Photobioreactor system (sub-demonstration site 9.1).**
   A 2 400 m^2 closed tubular photobioreactor in Makrygiannis Park treats groundwater by removing salinity, nitrates and hardness to produce irrigation-quality water for urban green spaces. The system combines ultraviolet disinfection, microalgae-based purification and smart monitoring. After treatment, water is transferred to settling and buffer tanks for biomass harvesting, analysis, irrigation or recirculation. This solution demonstrates how ecological treatment systems combined with digital controls can support circular and climate-resilient urban water management.
2. **Subsurface rainwater harvesting system (sub-demonstration site 9.2).**
   Located in Anthi Christofidou Park, this nature-based solution transforms a water-dependent green space into a self-sufficient urban park. A subsurface rainwater collection system, smart storage tanks and sensor-controlled irrigation replace water truck deliveries with locally harvested rainwater. Permeable paving enhances infiltration, reduces run-off and supports groundwater recharge while preserving existing trees. The result is a climate-resilient urban park with reduced operational costs and improved environmental performance.
3. **Green façade with vertical gardening and hydroponics (sub-demonstration site 9.3).**
   In Nicosia's historic centre, a vertical green façade integrates hydroponic and aquaponic systems to circulate and purify water for urban planting. Water is treated through ultraviolet disinfection and distributed via circular drip irrigation, with future potential to incorporate grey water and groundwater sources. Smart sensors, data loggers and monitoring systems optimise plant growth conditions, supported by a seed bank and plant incubation systems. The façade combines urban greening, water reuse and local food production within a compact city space.

Co-benefits

Economic

The Nicosia demonstration sites generate economic benefits by reducing operational costs and enabling resource recovery. The photobioreactor reduces municipal irrigation water demand and creates potential value from harvested microalgal biomass through circular economy applications. The rainwater harvesting system eliminates water trucking costs and reduces maintenance needs while improving the value and efficiency of urban green infrastructure.

Social

The interventions enhance urban liveability by creating cooler, greener and more inclusive public spaces. The photobioreactor supports healthier urban environments and raises awareness of sustainable water management. The rainwater park provides accessible recreational space and improves community well-being. The green façade fosters engagement with sustainable urban agriculture and strengthens awareness of climate-friendly food and water systems, including for vulnerable groups.

Environmental

The demonstration sites deliver strong environmental benefits through integrated water and ecosystem management. The photobioreactor improves groundwater quality by removing nitrates and salinity, supporting drought-resilient irrigation. The rainwater harvesting system improves stormwater management, reduces run-off and enhances groundwater recharge while mitigating urban heat. The green façade enables circular water use, reduces emissions through local food production and increases vertical urban greening and biodiversity.

Replicability – *Who can use this approach and how*

Nicosia's nature-based solutions, replication potential

Multifunctional solutions for sustainable urban development

Best suited for

The Nicosia demonstration sites are best suited for municipalities, urban planners and public authorities seeking to implement sustainable water management through multifunctional nature-based solutions. They are particularly relevant for water-stressed cities aiming to integrate climate resilience, ecosystem restoration and urban regeneration in a single approach.

Stakeholders' role

The Nicosia future gardens project involves a multistakeholder framework, including municipal authorities, technical partners, research institutions and local communities. Municipal stakeholders lead implementation, research organisations support monitoring and evaluation, and citizens contribute through engagement activities such as workshops and urban agriculture initiatives. This collaboration ensures both technical robustness and strong local ownership.

Built-in scalable tools

The demonstration sites are designed with replication in mind. Modular interventions, such as vertical gardening systems and rainwater harvesting units, can be adapted to different urban contexts. Smart monitoring systems enable remote management and performance tracking, while standardised technologies support cost-effective deployment. In parallel, structured community engagement frameworks help ensure long-term local acceptance and ownership.

Funding pathways

The Nicosia demonstration sites were funded through the EU Horizon Europe programme under the Cardimed project. Their multifunctional design enhances their attractiveness for complementary funding sources, including urban innovation programmes, climate adaptation funds and potential public–private partnerships. This strengthens their scalability and supports wider systemic deployment beyond the project framework.

Nicosia project · **Cardimed fiche** · **Cardimed policy brief** · **CORDIS**

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Ecosystems and nature-based solutions

Nature-based solutions | Urban greening | Pollution reduction

C ardimed's nature-based solutions in the Aix-Marseille metropolitan area

Nature-based solutions and soil unsealing for enhancing climate resilience

Climate hazards:

Main themes:

Aix-Marseille metropolitan area, France

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

Projected temperature increase of
+ 1.9 to + 4.6 °C
for the region by the end of the 21st century

8 000 m²
of soil progressively unsealed and
280
trees and shrubs planted

Implementation timeline

2023–2028
Cardimed project timeline

Solutions

Through the Cardimed project, the region aims to implement a series of nature-based solutions (NBS) to reduce urban heat, improve storm water management and restore urban biodiversity by unsealing sealed surfaces and expanding green infrastructure. The solutions demonstrated in Marseille include the following.

1. **Urban soil unsealing and terracing.**
Urban soil unsealing and terracing are used as NBS to reverse the effects of sealed, artificial urban surfaces and improve climate resilience. The approach involves removing impermeable coverings such as asphalt or concrete, decompacting and restoring soil functions and, where needed, reshaping sloped land through terracing to stabilise terrain and better retain water. Its purpose is to restore soil permeability and ecological performance, helping rainwater infiltrate rather than run off while supporting vegetation establishment and reducing heat stress. Expected benefits include improved storm water infiltration, reduced flood risk, lower surface temperatures, enhanced biodiversity, reduced erosion and more attractive and climate-resilient public spaces.

2. **Microforests and green corridors.**
These solutions create small, dense urban forests linked by vegetated corridors to strengthen ecological connectivity across the city. These interventions reduce urban heat, improve air quality, reconnect fragmented habitats, retain storm water and create greener, healthier neighbourhoods for residents. By combining compact tree planting with connected green spaces, the solution supports climate resilience and provides benefits for both people and urban ecosystems.

3. **Porous surfaces and bioswales.** These solutions support climate change adaptation by allowing rainwater to infiltrate into the ground rather than rapidly running off sealed surfaces. This reduces flood risk during heavy rainfall, supports groundwater recharge and helps cool urban areas by retaining moisture in the soil. Bioswales also filter pollutants from storm water, improve water quality and create small but valuable habitats for plants, insects and other organisms in urban areas. Together, these solutions demonstrate how nature can replace or complement conventional grey infrastructure while delivering multiple climate, environmental and social benefits.



Co-benefits

Economic

By reducing flood damage, lowering maintenance costs and limiting the need for expensive grey infrastructure, these solutions provide long-term savings for municipalities. Greener neighbourhoods can also increase property values, create local jobs in landscape management and strengthen the local green economy through the more sustainable use of water and natural resources.

Social

The project contributes to healthier and more liveable neighbourhoods by increasing access to green spaces, reducing heat exposure and creating more pleasant public areas. Community involvement in the design and implementation of the solutions also strengthens local ownership while helping ensure that vulnerable groups benefit from climate adaptation.

Environmental

The proposed NBS provide important environmental co-benefits by improving water quality and availability, enhancing groundwater recharge and reducing flood and erosion risks. They also restore habitats for plants and animals, help regulate the climate through carbon sequestration, reduced CO_2 emissions and urban cooling, and support biodiversity and soil health. In a coastal city such as Marseille, reducing polluted run-off also helps protect the Mediterranean Sea and its ecosystems.



Replicability – *Who can use this approach and how*

Learning from Aix-Marseille

How cities can restore nature while reducing heat and flood risks

Best suited for

This demonstrator is particularly suitable for replication by local and regional public authorities, notably municipalities, metropolitan authorities, water agencies and urban planning bodies, as they are well placed to embed NBS in land-use planning, storm water management, biodiversity strategies and climate adaptation policies. The model is particularly relevant for Mediterranean and other climate-vulnerable cities seeking to reduce urban heat, manage storm water naturally and increase biodiversity through NBS.

Stakeholders' role

The demonstrator was developed through close collaboration between Aix-Marseille University and the City of Marseille, with the university campuses serving as pilot sites. All regional stakeholders (public authorities, private sector, local associations) have been involved in the project from the outset in order to optimise the wider deployment of the solutions across highly urbanised areas.

Built-in scalable tools

The project provides a practical framework for integrating soil unsealing, microforests, bioswales, green corridors and porous asphalt implementation into urban planning. Because these interventions are modular, low-tech and adaptable to local conditions, they can be replicated progressively in cities of different sizes while delivering multiple climate resilience benefits.

Funding pathways

The demonstrator was developed through the Horizon Europe-funded Cardimed project under the EU Mission on Adaptation to Climate Change and a grant from the water agency. The successful implementation of these NBS can help cities mobilise additional investment from regional, national and EU funding programmes, while also creating opportunities for public–private partnerships in urban regeneration, water management and green infrastructure.

Mission story • Cardimed • Project factsheet • Project policy brief • CORDIS

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Ecosystems and nature-based solutions

Nature-based solution for recharging the Garonne River's aquifer, France

Restoring groundwater to secure river flows in the Garonne Basin

Replenishing groundwater to sustain flows, cool rivers and restore wetlands in drought-prone Nouvelle Aquitaine

Climate hazards:

Lot-et-Garonne, France, rural landscape

Contact: The nature-based solutions for Atlantic regional climate resilience project coordinators: Mindert de Vries / Michiel Blind, Deltares
Email: contact@nbracer.eu

Key figures

65 %
of the Garonne's water in the region supports **70** different agricultural activities

8–10 hm^3
of water filtrated into the alluvial aquifer to recharge the groundwater table

Implementation timeline

4 years
The nature-based solutions for Atlantic regional climate resilience project spans from 2023 to 2027

Solutions

The project enhances the natural and artificial recharge of the Garonne's alluvial aquifer to sustain low flows during droughts, to cool water temperatures and to restore hydraulic connectivity within the river and its connected wetlands.

1. **Artificial recharge of the alluvial aquifer.** **Eight to ten cubic hectometres of water** has been filtrated into the Garonne's alluvial aquifer in the Tonneins commune to sustain low-flow periods.
2. **Enhanced infiltration from river to aquifer.** The project promotes surface water infiltration from the Garonne into its alluvial groundwater table during high-flow periods.
3. **Thermal dilution of surface waters.** The Garonne has been recharged with cooler water to lower river temperatures, improving water quality and aquatic habitats.
4. **Restoration of hydraulic connectivity.** Links are maintained between the Garonne, its alluvial water table and connected wetlands.
5. **Water reuse for recharge.** The project tests the societal acceptability of reusing treated water from agriculture and gravel pits activities.

Co-benefits

Economic
The project strengthens agricultural resilience in the region, which provides water for approximately 70 sectors, reducing drought-related risks and boosting economic stability. It also helps safeguard key economic activities dependent on water availability, including agriculture and inland navigation.

Social
Increased water security for agriculture and human consumption reduces user conflicts. Stakeholder and citizen engagement helps assess the acceptability of different water reuse options and fosters trust in innovative water management practices.

Environmental
The project sustains aquatic ecosystems by cooling summer river temperatures through thermal dilution. It reconnects the Garonne with its alluvial aquifer and wetlands, restoring vital ecosystems that serve as biodiversity refuges and ecological corridors, while enhancing overall ecosystem resilience to climate stress.

Replicability – *Who can use this approach and how*

Scaling up groundwater recharge in alluvial river systems

Nature-based solutions strengthening drought resilience and restoring river–aquifer systems

Best suited for
This approach is particularly suitable for river basins with connected alluvial aquifers where groundwater and surface water exchanges naturally occur. It is most relevant in regions experiencing recurring droughts, declining summer baseflows and rising water temperature stress, especially where agriculture, ecosystems and urban water demand depend on the same hydrological system.

Stakeholders' role
The model relies on a multistakeholder governance system combining regional and local authorities, water agencies, farmers, researchers, landowners and citizens. This collaborative structure is critical for negotiating water allocation trade-offs, ensuring acceptance of reuse options and embedding solutions into existing water governance frameworks.

Built-in scalable tools
The nature of the approach allows for the gradual expansion of infiltration zones along the river, enabling modular and site-specific replication without major system redesign. Stakeholder and citizen engagement, particularly in water reuse, supports acceptance, reduces conflicts and enables wider uptake across the basin.

Funding pathways
Pilot actions are funded through Horizon Europe, while scaling up is enabled by integrating solutions into regional water management and climate adaptation plans, unlocking access to national and EU funding and supporting long-term investment.

Nbracer.eu · CORDIS.eu · Établissement Public Garonne

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Ecosystems and nature-based solutions

Check dams | Prescribed burning | Fire risk management plan

Using nature-based solutions to strengthen resilience to floods and wildfires on Evia Island, Greece

Using a combination of measures to tackle multiple hazards at once

Climate hazards:

Evia Island, Greece

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g.alexiou@wwf.gr, World Wide Fund For Nature Greece

Key figures
Tackling
2 hazards
simultaneously

Implementation timeline
5 years
2023–2028

Solutions

The Natalie project aims to help EU regions adapt to climate change by developing and promoting nature-based solutions (NBS) that strengthen environmental and community resilience. One of the case studies is in the Lilas River Basin on Evia Island in Greece. This region is vulnerable to both floods and forest fires. The high flood risks stem from extensive interventions in the riverbed, along with high urbanisation within the river's estuary. The region has also suffered from a long history of forest fires, caused by different factors including changing climatic conditions and human activities. Measures are being implemented to target both of these hazards.

1. **Flood control.**
A minimum of 50 wood check dams will be constructed in an ephemeral tributary of Lilas River. Historically, these dams have been used for collecting water for irrigation and other purposes for hundreds of years across the Mediterranean. They will be constructed to reduce flood risks and increase water percolation, recharging the aquifer. The locations of the check dams were identified through a multi-criteria analysis complemented by consultations with local authorities.

2. **Wildfire control.**
Prescribed burning is being carried out to manage forest fuel that accumulates in the area, reducing the risks of fires starting and spreading. The locations of the prescribed burning will be identified based on a fire risk map to be developed on multiple criteria, including vegetation and historical fire data. Additionally, a municipal fire risk management plan was developed to assess wildfire risk and support informed decision-making.



Co-benefits

Economic

By reducing flood and wildfire risk, these measures can help lower the costs associated with disaster response, infrastructure repair and property damages caused by these hazards. Long-term, investing in preventive nature-based approaches can be more cost-effective than relying solely on grey infrastructure and business-as-usual practices.

Social

The case study strengthens community resilience by reducing the exposure of people, homes and the essential infrastructure on which communities depend to dangerous hazards. All measures were designed and implemented in a stakeholder engagement approach to encourage empowerment, collaboration and shared responsibility among the public for landscape management. These activities also help increase awareness of climate risks, making residents more aware of possible dangers and building a safer and more resilient community.

Environmental

Implemented measures offer environmental benefits beyond flood and wildfire risk reduction. Check dams capture sediment in areas recently affected by wildfires and help reduce soil erosion, while prescribed burning can also benefit biodiversity and enhance nutrient recycling.



Replicability – *Who can use this approach and how*

Scaling up resilience to floods and wildfires

Using traditional and green solutions to protect communities

Best suited for

This model is best suited for river basins and forested landscapes that face multiple climate hazards, particularly areas vulnerable to both flooding and wildfires. It is especially relevant in Mediterranean regions suffering from water scarcity, where traditional check dams and fuel management practices can strengthen climate resilience while supporting ecosystem restoration.

Stakeholders' role

Successful implementation depends on the engagement of multiple stakeholders. Local authorities, land managers, researchers and community members work together to identify suitable locations for nature-based solutions and support the development of the fire risk management plan. The project also uses a participatory process to identify opportunities for replicating nature-based solutions along the main course of the Lilas River, ensuring that future interventions reflect local knowledge and needs.

Built-in scalable tools

This case study is designed to support replication beyond the demonstration sites. In terms of flood risk control, the method of modelling and multi-criteria analysis for tributary and site selection for the construction of the dams can be replicated in similar regions on larger spatial scales. The fire risk map development followed by prescribed burning approach can also be transferred, beyond the existing pilot sites.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Natalie project, as part of the EU Mission on Adaptation to Climate Change.

Case Study · CORDIS · D5.1

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Ecosystems and nature-based solutions

Agriculture | Digital solutions | Governance | Water security

Strengthening the resilience of irrigated agriculture in the Italian Alps

Climate-adaptive water management through digital tools, stakeholder collaboration and regional policy reform

Climate hazards:

Main themes:

Piedmont, Italy

Contact: MountResilience project coordinator, Università degli Studi di Milano, Italy
Email: mountresilience@unimi.it

Key figures

+2°C
temperature increase registered over
60 years
Snow registered negative anomaly at altitudes of
1 600–1 700 m

Decrease of
6–8
annual rainy days in
10 years

Implementation timeline

5 years
The MountResilience project spans from 2023 to 2028

Solutions

MountResilience is a European project that supports mountainous regions and communities in adapting to climate change and transitioning towards a climate-resilient society. In Piedmont, an Alpine region in northwestern Italy facing rising temperatures, irregular precipitation and increasing water scarcity, the project addresses growing challenges to agricultural water management. Through collaboration between regional authorities, researchers, irrigation consortia and farmers, MountResilience develops technological innovations and governance reforms to integrate climate adaptation into regional policies while improving coordination across stakeholders. The solutions put forward through this project are as follows.

1. **Regional dashboard and farmer app.**
   A decision-support tool that integrates data on soils, crops, irrigation systems, water conditions and weather to provide a shared overview for planning and to enable farmers to plan irrigation more efficiently using real-time data and forecasts.
2. **Digital twin of the irrigation network.**
   A simulation tool that helps water managers in pilot irrigation consortia to plan daily operations and long-term strategies by modelling how water moves through the system using real and modelled data.
3. **Revision of regional irrigation law.**
   A working group led by the Regione Piemonte and University of Turin is updating the legal framework governing irrigation and land reclamation consortia to better integrate climate adaptation and biodiversity into regional policies.



Co-benefits

Economic

Through the MountResilience project, Piedmont aims to safeguard regional water-demanding production sectors by enhancing water security and adjusting agricultural operations to evolving climatic conditions. The proposed solutions aim at enabling farmers to plan irrigation more efficiently using real-time data and forecasts, while allowing water consortia to monitor and plan water distribution and evaluate irrigation performance. These solutions are designed to optimise water management under increasingly scarce or uncertain conditions. The project seeks to maintain agricultural output in the face of climate-driven disruptions to water availability, thereby addressing the socioeconomic dimensions of water management in an integrated manner.

Social

The MountResilience project in Piedmont aims to achieve social co-benefits through strengthened collaboration and dialogue among regional authorities, researchers, water consortia and farmers, addressing the increasing conflicts over water use. By fostering a structured, bottom-up and partnership-oriented approach to water governance, the project ensures that reforms respond to practical needs and strengthen institutional capacity. Continuous stakeholder engagement creates a shared understanding of water challenges through tools like the regional dashboard, which provides a common overview for planning across multiple levels. Additionally, the project seeks to influence citizen behaviours to effectively address specific climate impacts in mountainous regions, building community-level awareness and adaptive capacity alongside technological and governance improvements.

Environmental

The MountResilience project in Piedmont delivers environmental co-benefits primarily through the integration of climate adaptation and biodiversity considerations into the revision of the regional legal framework governing irrigation and land reclamation consortia. By optimising water management through the regional dashboard and digital twin of the irrigation network, the project contributes to more efficient use of surface and groundwater resources. Improved water coordination also has positive implications for the Po River and its delta's wet areas, supporting the preservation of these ecosystems under increasing climate pressure.

Replicability – *Who can use this approach and how*

Replicating water management solutions in mountainous agricultural regions

Transferable tools and governance models from the Piedmont MountResilience experience

Best suited for

Regions best suited to replicate the Piedmont solutions are those where agricultural areas in plains or lowlands depend on water originating from surrounding mountainous regions. Similarly situated regions experiencing altered hydrological patterns due to changes in snowfall, snowmelt and precipitation patterns would find the MountResilience approach applicable, particularly where competing water demands create scarcity and necessitate coordinated management between upstream mountain sources and downstream users.

Stakeholders' role

Replication of the Piedmont solutions requires engagement from multiple stakeholders working in coordination. Regional authorities play a central role in developing decision-support tools and driving legal and policy reforms. Farmers are essential as end users who apply irrigation evaluation tools at the farm level and provide practical input. Water and land reclamation consortia manage the irrigation networks and use tools such as the digital twin for daily operations and planning. Researchers and academic institutions contribute technical expertise and lead the revision of regulatory frameworks. Public authorities monitor water availability and guide future investments. Continuous dialogue with local stakeholders ensures that reforms respond to practical needs and strengthen institutional capacity, while citizens are also engaged to foster behavioural change in addressing climate impacts in mountainous regions.

Built-in scalable tools

The replicable elements of this project include the digital decision-support tools. Beyond technology, the governance model serves as a replicable component, involving the revision of regional legal frameworks through structured working groups that maintain a bottom-up, partnership-oriented approach with continuous dialogue among authorities, researchers, water consortia and farmers.

Funding pathways

The MountResilience project is funded through Horizon Europe under grant agreement number 101112876.

Piemonte, Italy | MountResilience · **Piedmont-leaflet-DIGITAL.pdf** · **CORDIS EU**

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Ecosystems and nature-based solutions

Cultural landscapes | Habitat restoration | Connectivity

Restoring important cultural landscapes in Alentejo, Portugal

Using a combination of multiple nature-based solutions and digital tools to restore Mediterranean riparian ecosystems and Montado habitats

Climate hazards:

Main themes:

Alentejo, Portugal

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

Restoration of over
10 km
of river banks

Planting of over
20 000
native plants

Implementation timeline

2023–2028
Cardimed project timeline

Solutions

The climate adaptation and resilience demonstrated in the Mediterranean region (Cardimed) project develops and scales up nature-based solutions to strengthen climate resilience across the Mediterranean. In Portugal's Alentejo region, one of Europe's hottest and driest areas, the project is restoring riparian ecosystems and the unique Montado landscape to reduce drought and wildfire risks while enhancing biodiversity and supporting traditional land management.

1. **Riparian restoration.**
The project restored more than 50 hectares of riparian vegetation using nature-based solutions such as green corridors, riparian buffers and native planting. Invasive species were removed, habitats for wildlife were created, and digital tools including geographic information systems, sensors and satellite data are supporting long-term monitoring and maintenance.

2. **Montado restoration.**
The project restored Portugal's traditional Montado landscape by reintroducing agroforestry practices that improve biodiversity, reduce wildfire risk and strengthen ecosystem resilience. Wildlife refuges were created and rainwater-based maintenance supports the long-term sustainability of the restored areas.

Co-benefits

Economic
Restoring riparian ecosystems and Montado landscapes strengthens agriculture, forestry and livestock production by improving ecosystem services and reducing the long-term costs associated with droughts, wildfires and land degradation.

Social
The project preserves the Montado landscape, an important part of Alentejo's cultural heritage and local identity. Workshops and stakeholder engagement also strengthen collaboration, raise awareness of climate risks and encourage community ownership of restoration efforts.

Environmental
The restoration improves biodiversity, reconnects fragmented habitats and strengthens ecosystem resilience through native vegetation and agroforestry practices. It also reduces wildfire risk while creating healthier habitats for wildlife.

Replicability – *Who can use this approach and how*

Restoring Mediterranean landscapes for climate resilience

Combining nature-based solutions, digital monitoring and traditional land management

Best suited for
This approach is particularly suitable for Mediterranean regions affected by drought and heatwaves and with an increasing wildfire risk. It is especially relevant for areas seeking to restore degraded ecosystems, improve ecological connectivity and strengthen the resilience of agricultural and forest landscapes.

Stakeholders' role
Successful implementation depends on collaboration between public authorities, environmental agencies, researchers, landowners, farmers and local communities. Because much of the restoration takes place on private land, strong partnerships and stakeholder engagement are essential for long-term success.

Built-in scalable tools
The restoration techniques, digital monitoring tools and stakeholder engagement approach can all be adapted to other Mediterranean regions with similar ecosystems and climate challenges. Together, they provide a practical framework for restoring degraded landscapes while strengthening climate resilience.

Funding pathways
The demonstrator was developed through the Horizon Europe-funded Cardimed project as part of the EU Mission on Adaptation to Climate Change. The project provides a model that can support future public and private investment in ecosystem restoration and nature-based solutions.

Cardimed.eu · DEMO7 · D5.1 · Policy brief · Workshop

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Ecosystems and nature-based solutions

Nature-based solutions | Urban greening | Infestation management

Cardimed's forest management in Aragon, Spain

Advancing heatwave resilience through nature-based solutions and forest management

Climate hazards:

Main themes:

Aragon, Spain

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

56 %
of the region covered by forests

Mistletoe infestation
in the Teruel forest

43.6 °C
modelled thermal stress index in Vadorrey schoolyard during a representative school-day heatwave

Implementation timeline

2023–2028:
Cardimed project timeline

Budget

EUR 1 500
initial investment

+ EUR 300/year
maintenance per school

Solutions

The Teruel province in Aragon is highly forested, but mistletoe infestation is increasingly threatening these forest ecosystems. At the same time, several urban areas are facing increasing heat and flood risks due to climate change. In Aragon, the Cardimed DEMO 6 combines two complementary approaches to strengthen climate resilience: restoring forest health through innovative mistletoe management and introducing nature-based solutions (NBS) in schools to reduce urban heat, improve storm water management and create healthier learning environments. The solutions put forward through this demonstrator are the following.

1. **Mistletoe infestation management.**
The solution combines large-scale mapping, targeted forest management and community involvement to address mistletoe infestation in public forests. By mapping 850 000 hectares using geographic information systems and drone-based remote sensing, the project will identify where infestations are most severe and use this evidence to guide measures such as pruning and thinning in 10 pilot plots. These measures aim to reduce mistletoe density, improve forest resilience and restore ecosystem health while also exploring commercial uses for the removed biomass to create local economic benefits. Environmental education and the active participation of students, local communities and forest managers are integral to the approach, helping build long-term stewardship while creating opportunities for the sustainable use of removed biomass.

2. **Nature-based solutions.**
NBS were introduced in two primary schools in Zaragoza to improve climate resilience while creating healthier and more attractive learning environments. At Maria Moliner Elementary School, the solution combines surface unsealing, low and medium vegetation and tree planting to improve climatic comfort in the schoolyard, while at Vadorrey Elementary School a vegetated pergola with climbing plants has been installed to provide shade, cooling and a more attractive outdoor space. Together, these interventions demonstrate how schools can become living laboratories for climate adaptation while improving children's well-being, and how NBS can simultaneously strengthen climate resilience, improve quality of life and create lasting environmental, social and economic benefits, offering practical models that can be adapted across Europe.

Co-benefits

Economic
The project demonstrates how forest restoration can generate economic value by transforming removed mistletoe biomass into bio-based products or renewable energy. In schools, NBS can reduce storm water management costs, lower cooling needs during heatwaves and decrease long-term maintenance costs by replacing conventional grey infrastructure with natural systems.

Social
Greener schoolyards encourage outdoor learning, physical activity and social interaction while improving children's well-being. By providing shade, cleaner air and cooler environments, the interventions reduce heat exposure and create more inclusive, attractive and enjoyable spaces for pupils, teachers and the wider community.

Environmental
School interventions improve biodiversity, reduce urban heat, enhance rainwater infiltration, improve air quality and reduce soil sealing. At the same time, forest restoration strengthens ecosystem health by reducing mistletoe infestation, increasing carbon storage, improving habitat quality and supporting the recovery of native vegetation. In addition, it contributes to wildfire prevention, as trees weakened or killed by infestation increase the accumulation of dry fuel in forests, thereby enhancing the likelihood, spread and severity of wildfires.

Replicability – *Who can use this approach and how*

Learning from Aragon

How healthier forests and greener schools can strengthen climate resilience

Best suited for

School-based NBS are particularly suitable for municipalities, schools and education authorities seeking affordable ways to reduce urban heat and improve children's well-being. The forest management approach is well suited to public authorities, forest owners and environmental organisations facing increasing pest pressures linked to climate change.

Stakeholders' role

The demonstrator brings together the government of Aragon, schools, research and technology centres, forest managers and citizens through a co-design approach that ensures the solutions respond to local needs while remaining scientifically robust.

Built-in scalable tools

The project combines practical NBS with digital tools that support climate planning and replication. These include resilience dashboards, decision-support tools, participatory digital platforms and scenario-based methodologies that help other regions assess climate risks, engage stakeholders and adapt the solutions to their own context.

Funding pathways

The demonstrator was developed through the Horizon Europe-funded Cardimed project under grant agreement number: 101112731. By demonstrating both environmental and economic benefits, including the valorisation of mistletoe biomass, the project creates opportunities to mobilise additional public and private investment for forest restoration, urban greening and climate adaptation.

Mission story • Cardimed • Project factsheet • Project policy brief • CORDIS

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Ecosystems and nature-based solutions

Climate resilience | Water retention | Nature-based solutions

A nature-based strategy for water management in Krásná Lípa, Czechia

Enhancing climate resilience through floodplain revitalisation and community engagement

Climate hazards:

Main themes:

Krásná Lípa, Czechia

Contact: Technische Universität Dortmund, Dortmund, Germany (Land4Climate project coordinator)

Key figures

1.5 ha
waterbed restoration area in the inner city

3 400
inhabitants living in Krásná Lípa

Implementation timeline

2023–2027
Land4Climate project timeline

Solutions

To address pressing climate challenges, including recurrent droughts, flash floods and heat stress, the region of Krásná Lípa (Czechia) has implemented a targeted nature-based solutions (NBS) strategy under the Land4Climate project funded by the EU Mission on Adaptation. This approach is centred on a landscape-scale revitalisation of the floodplain through a series of interconnected, small-scale interventions on private land, including the following.

1. **Small infiltration ponds.**
Small infiltration ponds are designed to capture and store storm water during heavy rainfall, thereby reducing peak flows and minimising downstream flood risks. By retaining water within the landscape, they also help mitigate drought impacts, ensuring gradual groundwater recharge and sustained soil moisture during dry periods. This dual function enhances both flood resilience and water security, addressing key climate vulnerabilities in the region.

2. **Supporting measures.**
Additional interventions include the closure and removal of drainage ditches, the creation of bioswales and the unsealing of surfaces. These measures work together to reduce surface run-off and deliver multiple co-benefits.

3. **Widening of the water channel.**
A nature-based revitalisation of a previously straightened and deepened inner-city watercourse has been carried out over an area of 1.5 hectares, restoring more natural hydrological and ecological functions.

4. **Tree planting**
Tree planting increases natural shading, helping to reduce heat stress during high-temperature periods while improving overall quality of life.

Co-benefits

Economic
The implementation of small infiltration ponds and complementary NBS in Krásná Lípa generates significant economic benefits by reducing long-term costs linked to flood damage and heat-related impacts. In addition, these measures enhance the attractiveness of local properties, increasing their value through improved flood resilience, aesthetic quality and ecological restoration.

Social
Social co-benefits include enhanced community well-being achieved through improved landscape quality and environmental conditions. Restored ponds, wetlands and green spaces create new recreational opportunities and serve as platforms for sustainability education and nature-based learning. These interventions also improve the local microclimate, helping to create cooler and more liveable environments that support public health and outdoor activities.

Environmental
The environmental co-benefits are significant and contribute to the restoration of ecological balance. Improved groundwater recharge and soil health strengthen ecosystem resilience, while enhanced habitats support biodiversity, including amphibians, insects and aquatic plants. The measures also reduce both drought and pluvial flood risks, stabilising water availability and limiting erosion and downstream impacts.

Replicability – *Who can use this approach and how*

Replicating Krásná Lípa's nature-based solutions

An inspiring framework for floodplain revitalisation and climate resilience

Best suited for
This NBS model is well suited for municipalities and regions seeking integrated solutions to flood and drought risks while also advancing biodiversity and ecosystem restoration. It is particularly relevant for areas within or near national parks, where landscape-scale restoration can align climate resilience with ecological protection. The approach is also highly applicable to communities aiming to combine water management, habitat conservation and sustainable land use. It offers a practical framework for engaging private landowners in restoration through voluntary agreements and transparent collaboration, helping balance private land use with broader public environmental benefits.

Stakeholders' role
Stakeholder engagement was central to the success of the Krásná Lípa approach. The project used collaborative workshops involving residents and the local advisory board to explain the purpose and benefits of the interventions, alongside voluntary agreements with private landowners where access to non-municipal land was required. Coordination with local and regional environmental authorities ensured legal compliance, while permitting processes were initiated early. Hydrologists and municipal engineers co-developed the technical design, ensuring solutions were both scientifically robust and locally feasible, strengthening trust and long-term acceptance.

Built-in upscaling tools

The project includes several scalable features that support replication, including modular implementation roadmaps, standardised monitoring frameworks and participatory engagement methods involving private landowners. These elements together form a flexible blueprint adaptable to other regions. The project's landscape-based approach to water management is inherently transferable and can be applied by communities seeking integrated solutions for flood and drought resilience, while also delivering biodiversity and land-use benefits.

Funding pathways

The strategy is primarily funded through the EU-supported Land4Climate project under the EU Mission on Adaptation to Climate Change, which provides core implementation resources. The municipality of Krásná Lípa also contributes by providing land and coordinating local actions. The monitoring and evaluation framework is designed to remain adaptable, enabling access to future funding sources as the project evolves. This ensures continuity, scalability and long-term impact beyond the initial funding cycle.

Land4Climate • **Project deliverable** • **CORDIS**

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Nature-based solutions for water

Green infrastructure for urban flood resilience

Separating rainwater from waste water sewers and deploying nature-based solutions to manage storm water, reduce pollution and build climate resilience

Climate hazards:

Main themes:

Aarhus, Denmark

Contact: Mathias Joachim Skov Pristed, Lone Telling
Email: pmajo@aarhus.dk, tnl@aarhus.dk

Key figures

85 %
nitrogen reduction

75 %
phosphorus reduction

Pilot tested against a real-life
40-year
rainfall event

Implementation timeline

2023–ongoing

Solutions

Aarhus has implemented an integrated **'sponge city' approach**, rethinking urban water management by working with nature rather than against it. Instead of rapidly channelling water away through pipes, the system is designed to **store, slow down and naturally filter rainwater** across the urban landscape.

1. **Sewer separation.**
Rainwater is diverted from the combined sewer system into a dedicated storm water network. This prevents the mixing of rainwater with waste water, effectively eliminating overflow events during heavy rainfall and significantly reducing pollution.

2. **Natural terrain design.**
The solution builds on the city's existing topography. Natural depressions and landscape features are used to guide water flows.

3. **Interconnected nature-based solutions.**
A network of retention ponds, bioswales, rain gardens and permeable surfaces has been created across the catchment. These elements work together as a system, capturing and storing water close to where it falls while gradually releasing it over time.

4. **Soil infiltration and natural filtration.** Dedicated infiltration zones allow water to seep into the ground, where soils naturally filter out nutrients, pollutants and sediments. This significantly reduces the volume of contaminants reaching rivers and coastal waters.

5. **Blue–green recreation hubs.** Water management infrastructure is fully integrated into public spaces. Parks, recreational areas and green corridors are designed to temporarily store water during heavy rainfall while providing everyday benefits for residents.

Co-benefits

Economic

By reducing flood damage and limiting the need for costly upgrades to conventional drainage systems, the approach provides a cost-effective alternative to grey infrastructure. It also lowers long-term maintenance and emergency response costs.

Social

The creation of attractive blue–green spaces enhances quality of life, offering new areas for recreation, social interaction and community activities. These spaces also strengthen citizens' connection to their environment and increase awareness of climate adaptation.

Environmental

The project delivers substantial improvements in water quality, with major reductions in nitrogen and phosphorus pollution. It also supports urban biodiversity, restores ecological functions and improves the overall health of aquatic ecosystems in and around Aarhus.

Replicability – *Who can use this approach and how*

Scaling up urban nature-based solutions across Europe

The Aarhus sponge city model has been designed with replication in mind. Its strength lies in combining **modular nature-based solutions**, robust data monitoring and strong stakeholder collaboration, making it adaptable to a wide range of urban contexts.

Best suited for

Cities with combined sewer systems, high levels of impermeable surfaces and increasing exposure to intense rainfall, particularly in temperate and northern European climates. This makes it especially relevant for many medium and large European cities already facing similar climate pressures.

Stakeholders' role

Successful implementation relies on close cooperation between municipal water utilities, urban planners, research institutions, citizens and private landowners. Clear role distribution ensures that the model can be easily transferred to equivalent governance structures across Europe.

Built-in scalable tools

Monitoring systems and satellite data help identify which interventions are most effective, enabling cities to prioritise investments and scale up solutions efficiently. Data-driven decision-making reduces uncertainty and accelerates deployment on a larger scale.

Funding pathways

Residents are actively involved in the design and use of blue–green spaces, ensuring long-term acceptance and maintenance. Strong local ownership is key to sustaining the performance and social value of the solutions over time.

> *'Nature-based solutions and using the existing terrain is paramount in adapting a city to climate hazards such as flooding, where climate adaptation measures also create a more liveable and recreative city.'*
>
> **Mathias Joachim Skov Pristed, project manager.**

Mission story • **Invest4Nature** • **aarhusvand** • **Mission adaptation portal**

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Ecosystems and nature-based solutions

Inclusive governance | Adaptive infrastructure | Nature-based solutions

Community-led, nature-based adaptation in Tallinn, Estonia

Rewetting Pääsküla Peatland to combat heatwaves, flooding and biodiversity loss

Climate hazards:

Main themes:

Tallinn, Estonia

Contact: Tallinn Urban Environment and Public Works Department
Email: meelis.uustal@tallinnlv.ee

Key figures

47 ha
of rewetted degraded peatland

400 volunteers
mobilised

Implementation timeline

2020–ongoing

Solutions

Peatland restoration in Tallinn, as part of the EU Mission on Adaptation to Climate Change, followed a nature-based approach that required hydrological restoration and subsequent monitoring while keeping the interventions community-based through adaptive infrastructure that allows for public access.

1. **Hydrological restoration.**
Degraded peatland has been rewetted to restore its natural functions of carbon storage, flood regulation and biodiversity. This is done by closing drainage ditches using peat dams based on hydrological modelling and ground surveys, to raise and stabilise the water table and create conditions for peat accumulation and long-term carbon storage.

2. **Monitoring.**
Vegetation has been continuously monitored and the site is designed to support the return of species that enable carbon dioxide removal.

3. **Adaptive infrastructure.**
Floating boardwalks that cope with fluctuating water levels have been installed to ensure year-round public access and ecological compatibility.

Co-benefits

Economic
The restoration of Pääsküla Peatland reduces the risk of urban hazards including flooding, heatwaves and wildfires, lowering the economic burden of disaster prevention, emergency response and recovery.

Social
Enhanced environmental ownership was encouraged through community participation in dam construction, invasive species removal and environmental education days. The project also strengthens the link between citizens and nature by providing accessible green space within the urban environment.

Environmental
Scientific assessments predict that rewetting the peatland will reduce carbon dioxide emissions by 0.8 to 3 tonnes per hectare per year. Within 20 years, the site can become a net carbon sink, and within 50 years, the ecosystem may be fully recovered, contributing to long-term climate regulation and biodiversity restoration.

Replicability – *Who can use this approach and how*

Transferable peatland restoration interventions for adaptation and mitigation

How regions can adopt Tallinn's nature-based approach for peatland restoration and community engagement

Best suited for
Regions facing increased flooding, extreme heat and peatland fire risks, particularly those with degraded peatlands or drained wetlands in peri-urban or urban areas. The approach is especially relevant where historical land drainage has reduced natural water retention capacity.

Stakeholders' role
The model is based on a shared governance approach combining municipal leadership, national technical expertise, non-governmental organisations and strong volunteer participation. This distributed responsibility reduces implementation pressure on public authorities while embedding the project in local communities, increasing durability and social legitimacy.

Built-in scalable tools
The approach is scalable and replicable because it relies on modular, low-tech interventions that can be implemented progressively, adapted to local conditions and carried out using locally available materials and skills, allowing regions to start small and expand over time. A key driver is the strong community dimension: by mobilising volunteers in hands-on restoration activities, the model reduces costs while fostering local ownership and long-term stewardship.

Funding pathways
EU programmes, national and regional budgets and complementary financing through climate adaptation or biodiversity strategies. The relatively low-tech nature of interventions makes them suitable for blended finance approaches and phased investments.

Mission story

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Ecosystems and nature-based solutions

Nature-based solutions for water and climate resilience

Restoring a river's course for climate adaptation

Restoring the Vendié River's natural bends and floodplain to recharge groundwater, reduce drought and flooding, filter pollution and rebuild wetland biodiversity

Climate hazards:

Main themes:

Nouvelle-Aquitaine, France

Contact: Yohana Cabaret, Nbracer regional coordinator

Key figures

+ 1.4 °C
warming since 1950

Rain
declining since 1950

Implementation timeline

2023–2027
The period of collaboration through the **Nbracer** project

Budget

EUR 6 million
overall

EUR 310 000/ha
for river restoration

Solutions

The Vendié River restoration reverses decades of channelisation, reconnecting the river with its floodplain and reactivating the wetland's natural water cycle.

1. **Hydrological survey and monitoring.** Piezometers and stream-flow measuring stations have been installed to map water dynamics. Satellite imagery also helps to establish baseline data before restoration.
2. **Stakeholder co-design.** The work takes place within an existing water governance framework where landowners, farmers and municipalities work together on land-use changes. The signed agreements relate mostly to the authorisation for works.
3. **Physical re-meandering.** The river channel has been reshaped to restore natural bends, slow water flow and reconnect floodplains, and obstructions have been removed to allow seasonal inundation.
4. **Geophysical monitoring.** Bordeaux INP and the Parc naturel régional du Marais poitevin are carrying out geophysical monitoring through a range of geophysical sensors and techniques to evaluate changes in aquifer recharge dynamics before and after the re-meandering of the river channel.
5. **Replication framework.** Open data sources and remote sensing have been used to identify other rivers in the Sèvre Niortaise watershed that are likely to adopt the same approach.

Co-benefits

Economic
Reduced agricultural losses from drought and flood, lower irrigation costs as groundwater recovers and nature-based tourism potential. It also contributes to long-term cost savings by reducing reliance on grey infrastructure and emergency response measures.

Social
Stronger water security for farming communities, improved flood protection and greater public connection to the wetland landscape. The project also enhances local awareness and acceptance of nature-based solutions.

Environmental
Restored river habitats and biodiversity tend to improve water quality, recharge of the Marais poitevin aquifer and greater ecosystem resilience. The re-establishment of natural hydrological processes also aims to support carbon sequestration and long-term ecosystem functioning.

Replicability – *Who can use this approach and how*

Scaling up river restoration across Europe

The Vendié model is highly transferable. Its modular structure, tested stakeholder governance model and use of satellite monitoring help reduce both cost and complexity, making replication across other river systems straightforward.

Best suited for
The model is best suited for regions with channelised rivers, intensive agricultural activity, declining groundwater levels and high exposure to droughts or flash floods, particularly in temperate and Mediterranean climate zones across Europe.

Stakeholders' role
The model relies on a clearly defined set of stakeholders, including public authorities, watershed management bodies, universities, remote sensing providers and farming stakeholders, all of which can be correlated with equivalent institutions in other European river basins.

Built-in scalable tools
The model incorporates monitoring systems that identify which interventions are the most effective and transferable, while satellite-based tools support mapping, replication and scaling up across larger geographical areas.

Funding pathways
The model can be supported through a combination of funding sources, including local authorities, regional water agencies and relevant EU funding programmes.

> *'Restoring watercourses using nature-based solutions has a positive impact on the environment and the associated activities. The aim is to multiply these actions in the future for a better adaptation to climate change in the region*
>
> **Bordeaux INP and Sorbonne Université**

Mission story • Parc Marais poitevin • France-3 • Parc naturel régional du Marais poitevin – Nbracer

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Ecosystems and nature-based solutions

Nature-based solutions | Public–private partnerships | Community well-being

Addressing climate risks through nature-based solutions in Euskirchen, Germany

Transforming urban spaces to boost resilience, biodiversity and community well-being

Climate hazards:

Main themes:

Euskirchen, Germany

Contact: Mr Achim Blindert,
General Representative
County of Euskirchen District Administration

Key figures

1 urban park
established

Implementation timeline

Since 2023

Solutions

Supported through the EU Mission for Adaptation to Climate Change project Land4Climate, Euskirchen established nature-based solution interventions to address climate hazards.

1. **Tiny forest and climate park inauguration.** In May 2025, Euskirchen inaugurated its first Tiny Forest and Climate Park, marking the implementation of the county's first nature-based solution under the Land4Climate project, in partnership with the municipal housing company Eugebau. The park was created from a previously disused urban space, transforming it into a green and climate-resilient area.

2. **Public-private partnership.** The establishment of the Tiny Forest and Climate Park was made possible through strong public–private cooperation. The municipal housing company provided the land, local authorities led the design and implementation, and citizens actively supported and embraced the intervention, all under the guidance of the Land4Climate project. This partnership highlights the key role of private landowners in enabling nature-based solutions in urban areas.

Co-benefits

Environmental

The Tiny Forest and Climate Park helps mitigate local climate impacts by reducing the urban heat island effect and increasing water retention capacity, thereby contributing to flood risk management. The park was designed using native plant species, enhancing local biodiversity. It is expected to develop into a mature, self-sustaining forest ecosystem within the next decade.

Social

This community-driven project strengthens social cohesion by involving multiple stakeholders across the county. The public–private partnerships established provide a foundation for future collaboration. The involvement of local authorities ensures that the design is context-specific and aligned with community needs. The park offers a cool, shaded public space, improving health and well-being by providing relief during heatwaves and creating opportunities for recreation, education and community interaction.

Economic

The Tiny Forest and Climate Park demonstrates a cost-effective approach to urban adaptation, relying on low-tech, nature-based solutions to reduce long-term costs associated with climate impacts, such as flood-related infrastructure damage. It may also contribute to lower public health expenditures by reducing heat-related illnesses. In addition, the park can boost property values and attract environmentally conscious businesses and visitors, illustrating how targeted green investment can support long-term economic resilience.

Replicability – *Who can use this approach and how*

Replicating public–private partnerships for nature-based solutions: models, tools and financing pathways

From Euskirchen to other counties

Best suited for

This model is best suited for counties that include both public and private stakeholders who may individually lack the expertise or financial capacity to implement climate interventions but are open to collaboration through partnerships. It is particularly relevant for areas seeking to develop cost-effective and scalable adaptation solutions. In addition, the type of nature-based solution implemented is well suited to regions with populations vulnerable to heat stress and flood risks.

Stakeholders' role

This approach is based on a collaborative governance model that brings together a diverse set of stakeholders, including local and regional authorities, private-sector partners, EU-funded projects and citizens. Each stakeholder contributes complementary capacities, such as regulatory support, investment potential, technical expertise and local knowledge.

Built-in scalable tools

Nature-based solutions are inherently scalable, as they can be tested through small pilot interventions and progressively expanded across larger territories. This flexibility allows stakeholders to adapt implementation to local conditions, available resources and evolving climate risks.

Funding pathways

This intervention combines public funding, particularly through the EU Mission on Adaptation to Climate Change and projects such as Land4Climate, with private financing mechanisms. This blended approach helps to reduce investment risks while mobilising additional resources for implementation.

> *'I congratulate the residents on the climate park and the tiny forest. It is now their park and their tiny forest! They shall experience and enjoy it as a piece of nature on their doorstep (where they can snack on berries and fruits), and they shall take good care of it!'*
>
> **Mr Achim Blindert, General Representative, County of Euskirchen District Administration**

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Ecosystems and nature-based solutions

Building climate-proofing | Resilient urban systems

Herne's bottom-up approach to climate-resilient urban planning

Integrating legal frameworks, citizen engagement and evidence-based tools for scalable adaptation

Climate hazards:

Main themes:

Herne, Germany

Contact: Stadt Herne, Fachbereich Umwelt und Stadtplanung: Kerstin Agatz, Julia Landowski, Daniel Wirbals
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Key figures

Rise in tropical nights and hot days
registered over the past few decades

+ 2.3 °C
projected warming by
2050

Implementation timeline

Since 2019

Solutions

The city of Herne has taken a proactive and integrated approach to climate risks such as heatwaves and flooding by embedding climate adaptation directly into urban planning and building regulation. Since the adoption of its climate adaptation plan in 2019, adaptation has become a binding element of local planning, ensuring that every new development systematically contributes to long-term resilience.

1. **Strategic framework.**
Climate adaptation is legally embedded in urban planning and building processes, making resilience a mandatory requirement rather than an optional consideration in all new developments and renovations.

2. **Tools and instruments.**
The climate adaptation map identifies current and future risk hotspots for heat and flooding up to 2050, while also highlighting social, economic and environmental conflicts to guide targeted interventions. The climate adaptation catalogue provides a scalable set of measures applicable at the city, district, building and behavioural levels. These tools are reinforced by checklists and a scoring system that introduces a structured four-step assessment for all planning projects, covering area risk, project impact, selection of measures and a final climate score that determines approval.

3. **Scoring system in practice.**
Projects are evaluated through a binding scoring logic: developments scoring below -6 points are rejected, while those above +2 points are considered 'very well adapted'. To discourage sealing, impermeable surfaces incur penalties (- 1 point), which must be compensated through resilience measures (+ 1 point each), ensuring net climate-positive design outcomes.

4. **Practical implementation measures.**
Herne integrates green and climate-resilient infrastructure into everyday planning. This includes green roofs and façades, permeable surfaces, light-reflective materials and ventilation corridors to reduce heat stress. Private developments must also incorporate flood prevention and water management solutions such as rainwater reuse systems and protective barriers. These requirements are enforced through a mandatory climate check linked to building permits, ensuring that both public and private projects actively contribute to citywide resilience.

5. **Climate adaptation for homeowners.**
The climate check system extends climate responsibility to private homeowners, requiring the integration of adaptation measures when applying for building permits. The checklist offsets the impacts of surface sealing by rewarding each resilience action taken, ensuring that even small-scale renovations contribute to broader urban resilience while reducing long-term risk and costs.



Co-benefits

Economic

Herne's climate adaptation strategy delivers substantial long-term cost savings by reducing exposure to climate-related damage. Flood-resilient infrastructure such as permeable surfaces and rainwater reuse systems lowers the risk of costly repairs and emergency responses after extreme rainfall events. At the same time, heat mitigation measures like green roofs, façade greening and light-coloured materials reduce urban temperatures, lowering energy demand for cooling and easing pressure on health systems by reducing heat-related illness. By embedding these measures into mandatory planning rules, Herne shifts from reactive crisis spending to preventive investment, significantly reducing long-term public and private costs.

Social

Herne's approach strengthens social resilience by raising awareness and actively engaging citizens in climate action. The mandatory climate check encourages homeowners to consider risks such as heatwaves and flooding, fostering a culture of shared responsibility. Urban greening measures, including tree planting and green roofs, improve thermal comfort and public health by reducing heat stress in densely built areas. In combination with the climate adaptation map and targeted planning tools such as ventilation corridors, the strategy improves safety, comfort and liveability across neighbourhoods, contributing to more inclusive and resilient urban environments.

Environmental

Herne's climate adaptation measures deliver strong environmental co-benefits through the widespread use of nature-based and sustainable design solutions. Green roofs, façade greening and urban tree planting reduce the urban heat island effect and support biodiversity in built-up areas. Improved rainwater management through permeable surfaces and reuse systems enhances groundwater recharge and reduces pressure on drainage infrastructure, helping to mitigate flood risks. By penalising surface sealing and incentivising permeable alternatives through the climate check system, the city actively restores ecological balance while strengthening resilience to heatwaves and flooding.

Replicability – *Who can use this approach and how*

A scalable blueprint for urban climate resilience

How Herne's legally binding framework, standardised tools and multistakeholder approach can be adapted by other cities

Best suited for

Cities with dense urban structures, high heat and flood vulnerability, and existing planning frameworks can adopt Herne's legally binding climate adaptation plan. Herne's model is particularly relevant for industrial or post-industrial cities with limited green spaces and ageing infrastructure.

Stakeholders' role

To replicate Herne's model, local governments must lead with binding adaptation plans, supported by climate experts providing data, maps and scientific evidence, and national or regional funders. Homeowners, urban planners and any involved stakeholder implement measures via mandatory checks, while public engagement ensures acceptance. This multistakeholder collaboration involving governance, science and contributions from the private sector and citizens, is crucial for replication.

Built-in scalable tools

Herne's model includes built-in scalable tools designed for replication in other cities. The climate adaptation plan serves as a procedural blueprint, embedding adaptation into planning through standardised checklists, a four-step assessment grid and a climate adaptation catalogue with modular measures for different scales. The climate adaptation map identifies high-risk areas using local data, while the mandatory climate check for private buildings, with its scoring system, creates a replicable framework for homeowner engagement.

Funding pathways

Herne's climate adaptation initiatives were primarily funded through Germany's national climate protection initiative, a federal programme administered by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection. This funding supported the development and implementation of the 2019 climate adaptation plan, integrating adaptation measures into Herne's urban planning and building processes. The plan's legally binding framework ensures ongoing implementation through existing municipal budgets, embedding climate resilience into standard planning and development procedures.

> *'The municipal administration and city council have increased awareness of climate adaptation and intensified their engagement in a constructive dialogue concerning climate adaptation measures. The awareness of the need for climate adaptation has been implemented through the climate checks.'*
>
> **City of Herne**

Mission story • **Climate adaptation plan**

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Ecosystems and nature-based solutions

Sustainable forest management | Proactivity | Nature-based solutions | Citizen engagement

Emilia-Romagna: an innovative approach to water resilience

Lessons from Emilia-Romagna's post-disaster shift towards climate adaptation

Climate hazards: **Main themes:**

Emilia-Romagna, Italy

Contact: Arcadia project, arcadia_project@art-er.it

Key figures

540 km²
flooded

80 000+
landslides impacting

3 000
buildings and

300 km
of roads

EUR 8.5 billion
in damages

Implementation timeline

2024–2028
Arcadia project's timeline

Budget

EUR 275 million
needed

Solutions

Emilia-Romagna was one of the first regions in Italy to adopt a climate adaptation strategy, and it is now expanding it into a comprehensive climate strategy aimed at achieving climate neutrality by 2050. The approach combines planning, risk management and innovation through the following components.

1. **Integrated spatial planning.**
   Territorial planning is guided by preliminary flood risk assessments, enabling a detailed mapping of exposure and vulnerabilities across the region.
2. **Enhanced management practices.**
   Measures have been implemented to protect infrastructure in hydrogeologically vulnerable areas and on slopes. These include vegetation management and the monitoring of fossorial animals that may weaken soil stability and affect flood resilience, while also giving rivers more space to flow naturally.
3. **Co-innovation labs on nature-based solutions in the area of sustainable forest management.**
   Several innovative approaches and solutions have been pilot tested.
   (a) Sustainable forest management to tackle flood and landslide risk. Different forest management approaches are being assessed for their potential to enhance ecosystem services, with local stakeholders involved in a participatory process to identify and shape the most effective solutions.

(b) Sustainable forest management and payment for ecosystem services. This approach focuses on the mechanism to reward forest owners/managers implementing sustainable silvicultural practices through, 'sustainability credits', which assign economic value to multiple ecosystem services provided by forests.

(c) Nature-based solutions for water quality and quantity. Controlled infiltration areas are being designed and modelled in mixed rural and forested areas to increase water retention, support groundwater recharge and improve water quality, using vegetation and natural slope morphology to strengthen existing ecological processes.



Co-benefits

Economic

A proactive and anticipatory approach to flood risk management is significantly more cost-effective than post-disaster recovery.
The region estimates that approximately EUR 275 million is needed to protect the territory from hydrogeological risks, compared to EUR 8.5 billion in damages caused by the 2023 flood events. In addition, pilot initiatives are testing innovative financing mechanisms for sustainable forest management, including the sale of sustainability credits on voluntary markets.
It was estimated that the adoption of sustainable silvicultural practices – such as extending the harvesting cycles or non-utilisation of the allowable cut – causes income loss in the range of EUR 5 000 to 10 000/ha. To compensate for this loss, 'sustainability credits' are sold on the local market at a price equal to EUR 35 per credit.

Social

The 'closer-to-nature' approach promoted through the Arcadia pilot project, funded by the EU Mission on Adaptation to Climate Change, strengthens citizen engagement, community cohesion and awareness of ecosystem services. Through dedicated forums and participatory processes, local stakeholders are actively involved in knowledge exchange, innovation and the co-design of future forest management strategies.

Environmental

Vegetation management and nature-based solutions for water regulation contribute not only to decreasing water run-noff and hence reducing flood risk, but also to broader environmental benefits and natural capital enhancement. These include the restoration of natural water cycles, increased carbon storage, improved water quality and enhanced biodiversity across the region.
Local site and forest conditions need to be taken into account to maximise natural capital in all its components, parcel by parcel, distinguishing conversion to high forest through less frequent harvesting, coppicing with frequent harvesting, not active management.

Replicability – *Who can use this approach and how*

Replicating Emilia-Romagna's proactive approach to address climate challenges

A practical guide to local climate adaptation

Best suited for

This approach is particularly suited for regions exposed to increasing risks of flooding, landslides and hydrogeological hazards, seeking to shift from reactive, post-disaster recovery towards a proactive, anticipatory and cost-effective adaptation strategy. It is relevant for authorities aiming to integrate climate risks into long-term spatial planning and policy frameworks.

Stakeholders' role

The model is based on a collaborative and multilevel governance structure, ensuring integrated planning across sectors. The regional government leads the strategy, supported by a scientific advisory panel providing evidence-based input. Pilot actions under the Arcadia project further strengthen this approach by involving regional authorities, local experts, land managers and community stakeholders, ensuring both technical robustness and local ownership.

Built-in scalable tools

The approach is inherently replicable due to its methodological framework, which starts with the identification and mapping of risks and vulnerabilities to guide decision-making. This structured process can be applied across different territories. In addition, key measures such as stakeholder engagement, vegetation management and nature-based solutions are adaptable to local contexts. Pilot actions developed under the Arcadia project are specifically designed to test and demonstrate scalability and transferability.

Funding pathways

The model combines EU funding and regional investment to support both strategic planning and on-the-ground implementation. EU programmes have financed the pilot testing of solutions and methodologies through co-innovation labs, while the regional budget supports the broader climate strategy. In parallel, innovative financing mechanisms are being explored, including payment for ecosystem services and sustainability credits linked to sustainable forest management, offering additional pathways for long-term funding and replication.

Regional strategy • Mission story • Arcadia • Arcadia project • Living lab 1 • Living lab 2 • Living lab 3 • Project deliveries • CORDIS

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Ecosystems and nature-based solutions

Green infrastructure | Increased drainage | Increased well-being

Nature-based solutions for water management in Catania and Ferla, Italy

Implementing innovative urban drainage and vertical greening systems in Sicily

Climate hazards:

Main themes:

Sicily, Italy

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

Nature-based solutions across

4 400 m²
of urban land

30 m²
green facade

Implementation timeline

2023–2028
Cardimed project timeline

Solutions

As part of the Cardimed project funded under the EU Mission on Adaptation innovative nature-based solutions (NBS) to improve water management and strengthen climate resilience in Mediterranean environments are being tested in Sicily. The project aims to scale up climate adaptation by combining digital tools, stakeholder collaboration and replicable NBS. Two demonstration sites in Catania and Ferla showcase innovative approaches to stormwater management and water reuse.

1. **Catania: nature-based stormwater management.**
In the Tondo Gioeni roundabout, bioswales, bioretention cells (rain garden) and infiltration shaft were installed to intercept, retain and infiltrate stormwater run-off. This sustainable urban drainage system covers approximately 4 400 m² of public space and helps reduce the risk of flooding while improving urban stormwater management.

2. **Ferla: green facade for water reuse.**
At a local primary school, a 30 m² green façade system was installed to treat greywater from washbasins and reuse it for toilet flushing. The system combines vegetation with filtration technologies, ultraviolet disinfection, storage tanks, sensors and monitoring equipment to create a circular and resource-efficient water management solution.

Co-benefits

Economic

The solutions help reduce the costs associated with flooding and water scarcity. In Catania, nature-based stormwater management reduces pressure on drainage infrastructure and may lower maintenance and flood-repair costs. Improved flood resilience also helps minimise disruptions to economic activities such as transport and tourism. In Ferla, greywater reuse reduces water consumption and utility costs, while the green façade can reduce cooling needs during periods of high temperatures.

Social

The project improves quality of life by introducing visible green infrastructure into urban environments. In Catania, the rain garden enhances public spaces and contributes to making neighbourhoods healthier and more attractive. In Ferla, the green façade serves as a practical educational tool, helping students understand climate challenges and sustainable water management. Both interventions help to provide greener and potentially cooler environments that can improve comfort and well-being during periods of extreme heat.

Environmental

The interventions deliver multiple environmental benefits. In Catania, improved stormwater infiltration reduces run-off and decreases pollution entering waterways, while supporting groundwater recharge in a water-stressed region. In Ferla, the green façade promotes biodiversity by creating habitats for pollinators and other species while reducing the demand for potable water. Together, these solutions contribute to healthier ecosystems and greater long-term resilience to climate change.

Replicability – *Who can us this approach and how*

Scaling nature-based water management in water-scarce regions

A practical and adaptable model for addressing water scarcity, flooding and urban heat through green infrastructure

Best suited for

This approach is particularly relevant for Mediterranean, arid and semi-arid regions facing increasing water scarcity, urban flooding and heat stress. It is well suited to cities with extensive sealed surfaces, ageing drainage infrastructure and/or public buildings that could integrate green infrastructure and water reuse systems.

Stakeholders' role

The model relies on collaboration between municipalities, research institutions, technical experts, infrastructure providers, schools and local communities. Public authorities lead planning and implementation, while researchers and technical partners support design, monitoring and evaluation. Local stakeholders help ensure that solutions address community needs and local environmental conditions.

Built-in upscaling tools

The solutions are designed to be modular, low-tech and adaptable to different urban contexts. Bioswales, rain gardens, infiltration systems and green façades can be implemented using locally available materials and native vegetation. Monitoring systems provide evidence of performance and impact, helping cities assess benefits, build support and scale up successful interventions. The combination of NBS and practical monitoring tools makes the approach readily transferable to other regions.

Funding pathways

The approach was developed through the Horizon Europe-funded Cardimed project. Similar interventions can be supported through EU programmes, national and regional climate adaptation funds, urban regeneration schemes, water management investment and municipal budgets. Because these solutions deliver multiple benefits in relation to climate adaptation, biodiversity, water efficiency and public well-being, they can also attract funding from environmental, education and infrastructure sectors.

Mission story • CORDIS • Cardimed • Policy brief

This solution is part of Mission Solutions Catalogue



River revegetation | Nature-based solutions | Ecological connectivity

Pianton stream ecological restoration and transformative nature-based management

Reducing flood and landslide risks while enhancing habitats and community well-being

Climate hazards:

Main themes:

Venice, Italy

Contact: Office International de l'Eau, France (Natalie project coordinator)

Key figures

1 000 km²
extension of the drainage basin studied in this project

2 300 km
of streams in the Veneto region

Implementation timeline

2023–2028
Natalie project timeline

Solutions

Natalie's demonstrator in Veneto, Italy, aims at shifting from grey-infrastructure-based riverbank management to greener, nature-based approaches. It seeks to reduce flood and landslide risks while improving ecosystem quality, restoring natural river dynamics and increasing resilience to climate extremes such as heavy precipitation and heatwaves. The nature-based solutions tested through this demonstrator are the following.

1. **Gentle maintenance.**
Leaving uncut herbaceous vegetation at the base of riverbanks reduces soil disturbance and helps stabilise slopes, thereby lowering landslide risk while also increasing habitat availability and biodiversity. This low-intervention approach supports natural regeneration processes and reduces the need for intensive maintenance.

2. **Slope reduction, canal bed widening and revegetation.**
Reducing riverbank steepness and avoiding hard engineering solutions such as rock armouring allow for more natural bank reshaping. Combined with the widening of canal beds and the active revegetation of riverbanks, these measures improve hydraulic capacity, reduce flow velocity and enhance water retention during high rainfall events.

3. **Biodiversity and ecological connectivity enhancement.**
Nature-based measures implemented along riverbanks aim to strengthen ecological continuity along the stream network. By creating more continuous vegetated corridors, the project supports species movement, improves habitat quality and increases overall basin resilience by linking fragmented ecosystems into a more functional ecological network.



Co-benefits

Economic
The demonstrator's measures aim to deliver economic co-benefits by lowering long-term maintenance costs associated with grey infrastructure. Improved river stability and landscape quality can also enhance local amenity value and contribute to broader territorial attractiveness. A cost–benefit analysis is being developed to quantify these impacts and support evidence-based investment decisions.

Social
The project delivers social co-benefits by strengthening local capacities through training workers in nature-based river management techniques. This helps build professional skills, supports knowledge transfer and increases long-term awareness of sustainable approaches to river restoration and ecosystem management.
The active involvement of local stakeholders – including farmers, local institutions, education and academia, uninformed citizens, and land managers – fosters dialogue, trust and shared responsibility for river stewardship. This participatory approach improves acceptance of the implemented measures and supports long-term community engagement in climate adaptation and landscape restoration.

Environmental
The Natalie demonstrator delivers environmental co-benefits by restoring more natural river processes and improving the ecological condition of the stream corridor. The interventions reduce erosion and sediment transport, enhance habitat quality and support increased biodiversity along riverbanks and in aquatic ecosystems. By re-establishing more natural hydrological and morphological dynamics, the project contributes to healthier freshwater ecosystems and strengthens the overall ecological resilience of the river system under changing climate conditions. The adoption of the transformative NBS approach avoids impacts generated by traditional maintenance (materials and soil consumption, carbon emissions).

Replicability – *Who can use this approach and how*

A transferable model for nature-based riverbank management

A transferable model built on replicable design, governance innovation and stakeholder collaboration

Best suited for

The Pianton stream demonstrator is particularly well suited for replication by organisations and authorities in charge of channels and river management that are aware of the economic, environmental and social costs of traditional 'grey' practices and that are aiming to implement nature-based river management at a local or regional scale. It is especially relevant in contexts where there is a need to combine flood and landslide risk reduction with ecosystem restoration while also improving ecological connectivity and landscape resilience.

Stakeholders' role

The project brings together a broad partnership to support nature-based river management, including a university research laboratory, the regional government of Veneto, the Regional Environmental Protection Agency and stakeholders from the agricultural sector. Their combined expertise connects scientific research, public governance, environmental monitoring and practical land management. Further engagement with local stakeholders helps ensure that interventions are context-specific, socially accepted and grounded in local territorial realities.

Built-in scalable tools

This demonstrator is highly replicable because it combines nature-based interventions that can be adapted to different river and catchment contexts with a multi-actor governance model that supports coordination across institutions and sectors. Its participatory implementation approach strengthens local ownership and feasibility, while its evidence-based design and monitoring framework provide a solid basis for evaluating performance and supporting transferability to other regions.

Funding pathways

This project is funded by Horizon Europe under the EU Mission on Adaptation to Climate Change. It includes cost–benefit analyses that help build an evidence-based business case for scaling up the solutions. These assessments also support stakeholders in identifying potential funding opportunities and enabling the wider uptake of nature-based river restoration approaches.

Mission story • **Natalie** • **Mission projects catalogue** • **CORDIS**

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Ecosystems and nature-based solutions

Nature-based | Multifunctional | Transferable

Arcadia's climate adaptation living labs in Lower Austria

Co-developing nature-based solutions for regional resilience

Climate hazards: Main themes:

Lower Austria, Austria

Contact: ART-ER Attractiveness Research Territory, Arcadia's project coordinator arcadia_project@art-er.it
Office of the Lower Austrian Federal Government, Dept. of Environmental and Energy Management
alexis.sancho-reinoso@noel.gv.at

Key figures

20 000 km²
and
1.7 million
inhabitants in 573 municipalities

233 (out of 573)
municipalities of the Lower Austria region are part of the
KLAR! programme
on climate adaptation (data from July 2026)

Implementation timeline

2024–2028
Arcadia project's timeline

Budget

EUR 40 000/ha
for hedgerow planting

Solutions

Lower Austria, a region in the Arcadia project funded under the EU Mission on Adaptation to Climate Change, serves as a real-world testing ground for climate adaptation solutions across Europe. Facing increasing climate pressures such as water scarcity, drought, flooding and urban heat, the region has established three co-innovation labs: living labs to co-develop innovative nature-based solutions together with local communities, businesses, researchers and public authorities.

1. **Wagram.**
This co-living lab addresses the dual challenge of 'too much and too little water' in Lower Austria's agricultural landscapes, characterised by arable farming and viticulture. By implementing nature-based solutions such as multipurpose hedgerows and buffer strips, the project improves water retention, reduces soil erosion, enhances biodiversity and increases the resilience of agricultural systems to droughts and heavy rainfall events. Climate risk assessment focuses on mapping drought and soil erosion and includes the performance assessment of hedges.

2. **Wolkersdorf.**
The Wolkersdorf co-innovation lab focuses on making business locations more climate-resilient and sustainable. Nature-based solutions, including green façades, tree rows, permeable surfaces and biodiversity corridors, help reduce heat stress, manage storm water and improve local microclimates. The project also combines climate risk analyses with the co-development of planning and legal tools to support the wider replication of climate adaptation measures in industrial and commercial areas.

3. **Amstetten.**
The Amstetten co-innovation lab aims to transform the city into a cooler, greener and more liveable urban environment. It is inspired by the town's flagship intervention; namely, the redesign of the city's main square into one of Lower Austria's largest 'sponge city' projects, integrating permeable surfaces, rainwater retention systems and fresh-air corridors to reduce heat and flood risks. The lab combines climate risk assessment based on modelling future climate scenarios, the design of potential interventions such as green infrastructure, and strong community engagement to ensure inclusive and socially fair adaptation.



Co-benefits

Economic

The Arcadia co-innovation labs generate important economic co-benefits alongside their adaptation objectives. In Wagram, the estimated cost of planting hedgerows of shrubs and wild fruit and landscape trees is approximately EUR 40 000/ha (which can be partly covered by public funding schemes). The cost for planting rises if cultivated fruit tree species are added to the biotope, while also providing extra income from the fruit selling. Economic benefit is then generated by water-retentive landscapes and erosion-control measures that help protect agricultural productivity while reducing irrigation and land degradation costs. Wolkersdorf's climate-resilient business park lowers risks linked to heat and flooding, helping protect infrastructure, improve employee well-being and increase the attractiveness of the area for sustainable investment. In Amstetten, urban cooling interventions reduce energy demand for air conditioning, lower heat-related health costs and contribute to more attractive and valuable urban spaces. Together, the co-innovation labs demonstrate how climate resilience can support long-term economic sustainability and competitiveness.

Social

The co-innovation labs place local communities at the centre of adaptation planning and implementation. In Wagram, collaborative workshops and training activities strengthen farmers' knowledge and foster cooperation between stakeholders. Wolkersdorf improves working conditions through greener and cooler business environments while promoting dialogue between businesses, planners and environmental experts. In Amstetten, adaptation measures prioritise social inclusion and accessibility, ensuring that public green spaces benefit all residents. Across the three co-innovation labs, community participation strengthens climate awareness, social cohesion and local ownership of adaptation solutions.

Environmental

The Arcadia co-innovation labs deliver substantial environmental benefits through the large-scale integration of nature-based solutions. In Wagram, hedgerows and buffer strips improve biodiversity, reduce erosion and enhance water retention. Year-round soil cover lowers average soil loss by about 40 % compared with management without erosion protection. Adding hedgerows provides a further reduction of around 4 % and can prevent up to approximately 150 000 tonnes of soil loss per year (reduction of 44 % according to the most severe future scenarios). Field studies show that evaporation directly adjacent to a hedgerow can be reduced to approximately 50 % of the normal field value, thanks to lower wind speeds and partial shading within the sheltered zone, reducing potential agricultural yield losses.
Wolkersdorf's green infrastructure interventions help mitigate urban heat, improve air quality and support biodiversity within industrial areas. In Amstetten, blue–green infrastructure reduces temperatures, absorbs excess rainwater and creates healthier urban ecosystems. Together, these measures contribute to ecosystem restoration, pollution reduction and stronger long-term environmental resilience.

Replicability – *Who can use this approach and how*

Scaling up nature-based solutions for regional resilience: lessons from Arcadia's living labs

A replicable framework for multifunctional climate adaptation interventions

Best suited for

The Arcadia co-innovation labs in Lower Austria are designed as replicable models for regional climate adaptation across Europe. The labs' modular and co-created approaches are particularly suited for regions facing challenges such as water scarcity and flooding, urban heat or climate risks affecting industrial and commercial areas. The model can be adapted by municipalities, regional authorities and local partnerships seeking integrated and participatory adaptation solutions.

Stakeholders' role

The project relies on a multistakeholder governance model bringing together local and regional public authorities, climate adaptation platforms such as KLAR!, scientific and technical experts, businesses, community representatives and implementation partners, notably landowners. This collaborative structure ensures that solutions are scientifically robust, locally tailored and socially inclusive while strengthening cooperation between governance levels and sectors.

Built-in scalable tools

Arcadia demonstrates how blue–green infrastructure and nature-based solutions can be adapted to different territorial contexts. While interventions such as Wagram's biotope networks created with hedgerows, Wolkersdorf's climate-smart business parks and Amstetten's sponge city model provide practical examples, the project's main scalable asset lies in its participatory framework. By combining stakeholder co-creation, climate risk assessments, policy alignment and continuous monitoring, the model enables other regions to replicate core adaptation principles while tailoring measures to local needs and priorities.

Funding pathways

Funded through the Horizon Europe programme, Arcadia also illustrates opportunities for combining public funding with private-sector engagement. In Wolkersdorf, for example, businesses are investing in green façades, cooling measures and climate-resilient infrastructure to protect assets and improve working conditions. By linking climate adaptation with economic resilience and competitiveness, the project highlights pathways for private co-financing of nature-based solutions in industrial and commercial areas. Other examples are multipurpose hedges and land-use planning, for which an array of public funding options exist, being the most usual subsidies from the Austrian agro-environmental programme (ÖPUL) as part of the common agricultural policy.

Arcadia project • **Living lab 1** • **Living lab 2** • **Living lab 3** • **Project deliveries** • **CORDIS**

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Ecosystems and nature-based solutions

Nature-based | Solutions community | Co-design urban adaptation

De-sealing Luxembourg's urban spaces for climate resilience

Public call for projects replacing asphalt with ecosystems and nature-based solutions in public spaces

Climate hazards:

Main themes:

Sanem, Differdange, Luxembourg

Contact: Ministry of the Environment, Climate and Biodiversity
Email: verdissement@mev.etat.lu

Key figures

+ 0.8 °C
average temperature increase

2 586 km²

672 050
inhabitants

Implementation timeline

2023–2025
Sanem

2024
Differdange

Solutions

To address climate risks such as flooding and urban heat, Luxembourg's Ministry of the Environment launched two competitive calls (2023–2024) under the initiative 'more nature in our cities and villages'. The programme supports municipalities in replacing sealed surfaces with green infrastructure to strengthen biodiversity, climate resilience and quality of life. Projects were selected by experts and local stakeholders and transformed schoolyards, public spaces and streets into nature-based solutions. Winning projects include the following.

1. **Sanem municipality (2023).**
Sanem transformed a car-dominated street into a vibrant and climate-resilient public space. Asphalt was replaced with water-permeable crushed stone paths to reduce flood risks and lower surface temperatures during heatwaves. Native trees, shrubs and bee-friendly meadows were introduced to support biodiversity. The redesigned area now includes natural play spaces, community gardens and shaded seating areas built with locally sourced materials. Rainwater harvesting systems support sustainable irrigation, while the accessible layout encourages use by residents of all ages, combining climate adaptation with stronger social cohesion.

2. **Differdange (2024).**
Differdange transformed the Um Bock schoolyard from a sealed surface into a green educational and recreational space. Students actively participated in designing the project, selecting native plants and educational features such as outdoor classrooms. Concrete surfaces were removed and replaced with grass, trees and heritage plant species from Luxembourg's Minett region. In partnership with the University of Luxembourg, the project also supports teacher training on sustainability and environmental education. The redesigned schoolyard now helps reduce urban heat, supports biodiversity and reconnects children with nature through hands-on learning and stewardship.

Co-benefits

Economic
Luxembourg's de-sealing initiatives help reduce flood-related costs by replacing impermeable surfaces with permeable materials that improve rainwater infiltration and reduce pressure on drainage infrastructure. Greener and cooler urban spaces can also lower energy demand for cooling in surrounding buildings, while improved air quality and reduced heat stress may help decrease health-related costs. Differdange's schoolyard transformation, for example, creates a low-maintenance educational green space that combines climate resilience with long-term public well-being benefits.

Social
The projects create more inclusive and liveable urban environments by transforming sealed and underused spaces into welcoming community areas. In Sanem, shaded seating areas, gardens and natural play spaces encourage social interaction and accessibility for all generations. In Differdange, students' direct involvement in the design, planting and maintenance of the schoolyard strengthens environmental awareness and community ownership. Both projects improve well-being by reducing heat stress, increasing access to nature and creating shared spaces that strengthen social cohesion and quality of life.

Environmental
The de-sealing projects deliver significant environmental benefits by replacing impermeable surfaces with nature-based solutions that improve urban climate resilience. Permeable pathways and green spaces enhance rainwater infiltration, reduce flood risks and help mitigate urban heat. Native vegetation, bee-friendly meadows and regional plant species support biodiversity and create habitats for pollinators and local wildlife. By restoring soil functions, increasing vegetation cover and harvesting rainwater, the initiatives contribute to healthier urban ecosystems and support Luxembourg's broader Nature Pact objectives.

Replicability – *Who can use this approach and how*

Scaling up Luxembourg's de-sealing interventions

How community-driven nature-based solutions can inspire greener and more climate-resilient cities across Europe

Best suited for

This approach is particularly suited for municipalities seeking to reduce impermeable surfaces, expand urban green areas and improve resilience to flooding and heatwaves. With targeted grants, technical guidance and opportunities for peer exchange, local authorities can adapt these interventions to schools, public squares, streets and other sealed urban spaces.

Stakeholders' role

The projects were implemented through close collaboration between national and local stakeholders. Luxembourg's Ministry of the Environment, Climate and Biodiversity provided strategic guidance and financial support, while the municipalities of Sanem and Differdange led project design and implementation. Citizens, schools and local communities also played an active role through co-design processes and participation in planting and stewardship activities.

Built-in scalable tools

The de-paving techniques and nature-based solutions implemented are highly transferable and modular, making them easy to replicate in different urban contexts. Permeable surfaces, urban greening, rainwater harvesting, outdoor learning spaces and biodiversity-friendly planting schemes can all be adapted to local needs and scaled up progressively. Their proven climate, environmental and social benefits also facilitate alignment with EU and national sustainability objectives.

Funding pathways

The projects were primarily financed through Luxembourg's Climate and Energy Fund via competitive municipal calls, helping smaller local authorities access funding for climate adaptation projects. The multifunctional benefits of these interventions, spanning climate resilience, biodiversity, public health, education and social cohesion, also create opportunities to mobilise complementary national and European funding sources.

> *'Trees and green infrastructures are an added value for biodiversity and also the best way to combat heatwaves in urban areas. Especially in schools, it is therefore important to have a lot of nature in order to offer our children a better quality of life in their everyday life.'*
>
> **Serge Wilmes, Minister for Environment, Climate and Biodiversity**

Mission story • **Sanem project** • **Avenue 2025** • **Nature Pact**

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Ecosystems and nature-based solutions

River catchment | Twinning regions | Private-public collaboration

Using private land for nature-based solutions in the Upper Timiş River region, Romania

Fostering public–private relationship to use private land for the implementation of different nature-based solutions within the river catchment to tackle flooding and drought issues

Climate hazards:

Main themes:

Upper Timiş River, Romania

Contact: Technische Universitat Dortmund (Land4Climate project coordinator), Administrația Bazinală de Apă Banat (Land4Climate front-running region)

Key figures

2
types of hazards considered

5
types of nature-based solutions

Implementation timeline

2023–2027
Land4Climate project timeline

Solutions

The Land4Climate project, as part of the EU Mission on Adaptation to Climate Change, aims to strengthen the resilience of landscapes and urban areas using nature-based solutions (NBS) thanks to innovative approaches to access private land. The Upper Timiş River catchment in Romania aims to implement NBS across private land, targeting the main climate-related issues in the area, namely floods, drought and resulting riverbed erosion.

1. **Multi-criteria climate risk assessment.**
To select suitable locations for NBS implementation, climate risk hotspots within Timiş County were identified using a multi-criteria climate risk assessment. This assessment used hazard data, flood risk maps, exposure analysis and vulnerability indicators. This data provided an evidence base for targeted NBS planning.

2. **Nature-based solutions.**
Various NBS are being implemented in the catchment area:
   - restoration of ponds and wetlands;
   - construction of water retention channels;
   - enhancement of riverbank habitats;
   - river widening;
   - planting of trees and other types of greenery.

3. **Stakeholder engagement.**
NBS awareness events are organised by local authorities and project partners, with the aim of involving locals and private landowners in project activities. Such events allow residents to participate in different ways, such as volunteering for tree and greenery planting initiatives. Willing private landowners are encouraged to participate by making their land available for NBS implementation. They are also invited to act as ambassadors to the project, advocating for broader participation in this way among peers.



Co-benefits

Economic

The NBS implemented in the Upper Timiş River catchment are expected to reduce the economic impacts of floods, drought and riverbank erosion. Measures such as wetland and pond restoration, water retention channels, river widening and tree planting improve landscape water retention. This in turn helps to store water better, making more water available during dry seasons. It also slows surface run-off during heavy rainfall, helping to stabilise riverbanks. Together, these measures help to protect the surrounding agricultural land from climate extremes by storing water during drought conditions and reducing flood risks during wetter conditions. This reduces losses from the agricultural sector, which is economically important in the region, with many families relying on it for their income. Flood protection also reduces damage to nearby infrastructure, reducing recovery costs. By working with landowners to implement NBS on privately owned land, the project also promotes cost-effective, long-term climate adaptation across the catchment.

Social

The case study strengthens collaboration between the different actors involved in the project. Residents can participate in restoration actions, fostering a common sense of environmental action within the community. The innovative public–private approach encourages participating landowners to promote the wider uptake of NBS among their own circles, increasing collective action. The NBS themselves also contribute to making the sectors that many residents economically rely on more secure, protecting their quality of life. This collaborative approach builds local awareness of flood, drought and erosion risks, strengthening local capacity for climate adaptation and encouraging shared stewardship of the Upper Timiş River catchment.

Environmental

The NBS being implemented in the Romanian lake catchment restores and enhances both freshwater and riparian ecosystems while addressing the catchment's main climate challenges. Wetland and pond restoration, water retention channels, river widening, riverbank habitat enhancement and tree planting increase the landscape's capacity to retain water, slow run-off and reduce soil and riverbank erosion. These measures improve biodiversity and ecological connectivity, strengthen ecosystem resilience to prolonged dry periods and extreme rainfall and support the long-term health and functioning of the Upper Timiş River catchment.

Replicability – *Who can use this approach and how*

Scaling up climate resilience in collaboration with private landowners

Using this approach for NBS implementation

Best suited for

This model is best suited for regions with river catchments, where climate risks such as flooding and drought impact large areas of land, both public and private. It is particularly applicable to regions where conventional grey infrastructure alone cannot adequately address water management challenges, and where the implementation of NBS requires cooperation between public and private actors. The model is most effective where data such as flood risk maps and exposure analyses are available to help identify priority intervention areas, and where there is institutional capacity to coordinate long-term stakeholder engagement from design to monitoring of what is implemented.

Stakeholders' role

This model uses a collaborative governance model that combines scientific expertise, public authorities and private landowners. Research organisations conduct the technical work, such as conducting climate risk assessments, identifying suitable locations for implementation and supporting the monitoring of NBS. Water authorities coordinate the overall management of the catchment, such as agreements with local landowners. Private landowners play an important role by voluntarily providing land for NBS implementation, aiding in restoration activities and acting as ambassadors within their circles to encourage wider uptake of this project.

Built-in scalable tools

The model has been designed in such a way as to facilitate replication through structured knowledge exchange between frontrunning and replicator regions engaged in the project. Innovative approaches are being tested in five frontrunning regions, while in the five replicator regions these approaches are being adapted and applied depending on the local contexts. This twinning approach is supported by common methodologies for climate risk assessment, guidance on accessing private land for nature-based solutions, stakeholder engagement strategies, monitoring frameworks and policy recommendations developed through the project. The approach can be transferred beyond the project regions as it allows customisation to different contexts.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Land4Climate project, as part of the EU Mission on Adaptation to Climate Change.

Land4Climate • CaseStudy • CORDIS • D4.1

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Ecosystems and nature-based solutions

Local knowledge | Soil enrichment | Landscape restoration

Restoring mountain meadows for climate resilience in Râu Sadului and Cristian, Romania

Drone-assisted grassland revitalisation to combat drought, erosion and biodiversity loss

Climate hazards: **Main themes:**

Râu Sadului and Cristian, Romania

Contact: Rohealth – Cluster for Health and Bioeconomy
Email: projects@rohealth.ro

Key figures

Up to 55
hectares of study area

Up to 200 kg/ha
of approved organic amendment/ fertiliser

Implementation timeline

2023–2028

Budget

EUR 40–50/ha
scanning

EUR 80–150/ha
drone seeding

Solutions

Climate hazards are increasingly threatening the mountain meadows of the Râu Sadului and Cristian-Păltiniș municipalities in the Cindrel and Lotrului Mountains of Transylvania. Rising temperatures, changing precipitation patterns and soil degradation have reduced the share of valuable forage species, which are increasingly replaced by low-value or toxic plants. This has lowered both the nutritional quality and the biomass yield of the meadows, putting pressure on traditional grazing activities and local shepherd communities. In response, the MountResilience project is testing innovative meadow restoration techniques to strengthen ecosystem resilience and support sustainable mountain livelihoods.

1. **Surveying and monitoring.**
Prior to any interventions, the project team surveyed the study area using drones with multispectral cameras to better understand the environmental state of the area through vegetation mapping. Monitoring was prioritised as a next step in the project, using techniques such as soil sample analysis and botanical surveys. The data collected revealed degraded, acidic soils with large amounts of invasive vegetation.

2. **On-site interventions.**
Soil treatments were employed, such as mulching, nitrifying bacteria additions, soil amendments, targeted fertiliser usage, germination monitoring and seeding with productive mixtures. Drones were used for these tasks when steep slopes prevented the use of the usual machines or were difficult to reach on foot. All treatments varied in terms of altitude and soil type to ensure effectiveness.

3. **Community involvement.**
The regional demonstrator in the Cindrel and Lotrului mountain sites created an informal local consultative council, bringing together farmers, citizens, researchers, businesses and local authorities to co-develop climate adaptation strategies. This bottom-up approach is supported by online and on-site meetings, enabling dialogue and feedback on proposed measures. Local knowledge is gathered through this council and prioritised by decision-makers for regional planning.



Co-benefits

Economic

The restoration of the mountain meadows in Râu Sadului and Cristian-Păltiniș delivers significant economic advantages for local communities and regional agriculture. By revitalising degraded pastures, the project enhances fodder quality and quantity, directly benefiting livestock farmers, particularly the shepherds who rely on these meadows for grazing. Improved pasture productivity can increase milk production per hectare, while a better floristic composition can support higher-quality dairy products, increasing farmers' revenues. Additionally, the use of drone technology reduces labour costs and increases efficiency, making restoration efforts more cost-effective. In the long term, these interventions may help mitigate rural depopulation by making farming more sustainable and economically viable, ensuring that mountain communities can continue to thrive.

Social

These restoration initiatives foster strong social cohesion and empower local communities through participatory decision-making. The establishment of the local consultative council ensures that the restoration strategies being employed are locally relevant and, therefore, supported by stakeholders. This collaborative approach not only strengthens trust between stakeholders but also preserves traditional knowledge, which is placed at the forefront of adaptive planning. By involving residents in every stage, from planning to implementation, the initiative cultivates a sense of ownership and pride in the restored landscapes. This bottom-up engagement helps safeguard cultural heritage while adapting it to modern climate challenges.

Environmental

The restoration of Romania's mountain meadows yields substantial environmental benefits. The approach helps restore biodiversity and soil health in degraded meadows while preventing further biodiversity loss in areas that are not yet severely degraded, thereby increasing resilience to climate impacts. The reintroduction of native plant species and improvement of soil health through targeted measures help to revitalise essential ecosystems that support pollinators, birds and grazing livestock. The removal of invasive species further enhances the natural balance of the area. By increasing vegetation cover and biomass, healthier meadows can sequester more carbon per unit area, contributing to climate change mitigation while also enhancing water retention and reducing the risk of flooding and erosion during heavy rains. These measures contribute to long-term ecosystem stability, ensuring that these landscapes remain resilient for the wildlife and plant life that depend on them.

Replicability – *Who can use this approach and how*

A scalable model for climate-resilient meadow restoration

How this restoration approach can be adapted to different regions

Best suited for

This model is best suited for regions with degraded pastures, meadows and grasslands, where climate hazards threaten both the ecological balance of the area and traditional livelihoods in communities that depend on sectors such as small-scale farming and agrotourism. It is particularly effective in mountainous or hard-to-access areas, where steep slopes and rough terrain limit the use of conventional equipment, making drone-assisted interventions a practical solution. The bottom-up approach is also effective in areas where traditional knowledge is being lost, helping to preserve it.

Stakeholders' role

The project's multistakeholder framework ensures shared ownership and expertise. The EU-funded project team leads the overall coordination and funding and carries out most of the interventions. Local actors draw on their established networks to bring stakeholders together. The various stakeholders then contribute their own areas of expertise. For example, farmers and shepherds offer invaluable insight into grazing cycles and historical land use, while researchers can impart knowledge on the more technical aspects of the interventions.

Built-in scalable tools

The project incorporates several adaptive and modular features that make it easily scalable. Drone technology enables cost-effective, precise interventions on difficult terrain, reducing the need for labour-intensive methods and enabling the expansion of restoration across larger and more remote areas. Interventions are also customisable depending on soil type and altitude, maximising the replicability of the model in different environments. Monitoring systems, such as botanical surveys, allow for timely adjustments, ensuring strategies remain effective as conditions change. Knowledge-sharing measures such as the local consultative council ensure that models are constantly refined according to local needs.

Funding pathways

The support for these activities originates from the MountResilience project, which is funded by the EU Mission on Adaptation to Climate Change via the EU's Horizon Europe programme.

> *'The nutritional value of mountain pastures has deteriorated enormously in the last decade. We are testing innovative solutions – including using drones for scanning, seeding and fertilisation activities – to revitalise these regions.'*
>
> **Claudiu Șerban, agronomic engineer at the Research and Development Institute for Montanology Cristian, Sibiu**

Mission story • **MountResilience CORDIS** • **MountResilience**

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Ecosystems and nature-based solutions

Innovative | Scalable | Collaborative | Multifunctional

Southwest Finland's innovative climate adaptation planning for water resilience

A catchment-level approach to nature-based storm water management

Climate hazards:

Main themes:

Southwest Finland

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Key figures

10 910 km²
26 %
dedicated to agriculture
497 000
inhabitants, with
20 000
forest owners and
5 000 farmers
450+
stakeholders engaged

Implementation timeline

2023–2027
Resist timeline

Budget

EUR 930 000
allocated by Turku for the implementation of the Resist measures at the Rauvola pilot site

Solutions

The region of Southwest Finland advances innovative approaches to nature-based storm water management. Several nature-based solutions (NBS) pilot projects are being tested through the EU Mission on Adaptation to Climate Change's **Resist** (Regions for climate change resilience through innovation, science and technology) project, adopting a catchment-wide approach to storm water management in its pilot areas, Rauvolanlahti, Oriketo and the Savijoki basin, shifting from reactive drainage to proactive, watershed-level planning for future climate resilience by integrating multifunctional nature-based NBS, such as wetlands and restored streams. The project delivered the following tools.

1. **Blue–green factor assessment tool.**
   A decision-making evaluation tool used to assess urban developments based on their surface water management and vegetation quality. By scoring blue and green features, alongside other ecological elements, it measures a site's climate resilience. The tool helps urban planners incorporate green infrastructure and nature-based solutions, ensuring developments are better adapted to local environmental conditions.
2. **Rain garden catalogue.**
   An innovative resource shared between partner regions, promoting rain gardens as evidence-based NBS that, through shallow, landscaped depressions, are able to locally capture and absorb rainwater run-off from impermeable surfaces. These systems mitigate flooding, filter pollutants to protect waterways and support sustainable urban drainage by aligning with local hydrological needs. The catalogue also includes cost assessments and implementation timelines, making it a practical tool for climate-resilient urban planning.
3. **Cost–benefit analysis for NBS.**
   A tailored framework to evaluate the economic, social and environmental impacts of adaptation measures, weighing quantifiable benefits such as flood reduction, increased biodiversity and well-being improvements against implementation and maintenance costs. It supports evidence-based decision-making and adopts a locally adapted approach, accounting for regional challenges and non-monetary ecosystem services to prioritise sustainable resilient solutions.



Co-benefits

Economic

The Resist project in Southwest Finland delivers key economic co-benefits aimed at reducing costs by proactively building up resilience and adaptation to climate change. Through NBS such as wetlands, restored streams and storm water ponds, the project aims to lower flood and drought damages, cutting long-term infrastructure and emergency response expenses. Additionally, the cost–benefit analysis of NBS tools developed through the project provides policymakers with evidence-based economic justifications to ensure investment in multifunctional nature-based preventive measures. By improving water retention and reducing soil erosion, the project also aims to minimise agricultural losses, further strengthening regional economic resilience.

Social

The Resist project in Southwest Finland fosters significant social co-benefits by engaging with over 1 100 stakeholders, including landowners, businesses, decision-makers and citizens, to strengthen collaboration in climate adaptation. Through knowledge sharing and capacity building, the project enhances stakeholder understanding and acceptance of NBS, empowering local stakeholders to actively participate in sustainable water management. By developing tools for citizens and decision-makers to disseminate best practices, Resist ensures that communities are better equipped to implement and advocate for resilient, climate-adaptive measures.

Environmental

The project delivers key environmental co-benefits by implementing NBS such as restored wetlands, streams and storm water ponds, which enhance biodiversity and improve water retention capacity. These measures reduce flood and drought risks while improving run-off quality through natural filtration processes. Additionally, the project's catchment-level water management helps minimise soil erosion in rural and agricultural areas, contributing to greater climate resilience across Southwest Finland's urban and natural landscapes.

Replicability – *Who can use this approach and how*

A scalable model for catchment-level, climate-resilient water management

Public–academia collaboration with built-in tools for regional replication

Best suited for

This project is best suited for regions aiming to proactively tackle water-related climate risks at the catchment level through multifunctional NBS, supported by cross-sector collaboration.

Stakeholders' role

The Resist project is based on cross-sector collaboration, involving a public–academia consortium, including municipalities, regional council, universities and research institutes, alongside landowners, citizens and policymakers. To replicate this model, regions should prioritise involving local governments for planning, academic partners for scientific rigor, landowners/farmers or other local stakeholders for implementation and community groups for social acceptance, ensuring a holistic, catchment-level approach to climate-resilient water management.

Built-in scalable tools

The Resist project offers a replicable public–academia collaboration model that bridges research, planning and implementation, ensuring the seamless scaling up of climate adaptation efforts. It provides research-based evidence on the performance and benefits of NBS, facilitating wider adoption across regions. Central to its scalability is a catchment-level framework, applicable to storm water and agricultural and forestry water management, that integrates biodiversity considerations. Complementing this are transferable tools and digital models that are successfully being replicated in Eastern Macedonia and Thrace, Greece, and Normandy, France.

Funding pathways

The Resist project is co-funded by the EU through the Mission on Adaptation to Climate Change, providing the primary financial backbone for its implementation. To ensure long-term sustainability and scalability, the project actively engages the private sector by leveraging tools like cost–benefit analysis, which demonstrates the economic viability of NBS. This approach not only attracts private investment for implementation and maintenance but also fosters public–private partnerships, ensuring broader adoption and upscaling of the tested solutions. The city of Turku has allocated EUR 930 000 from its investment budget for the implementation of the Resist measures at the Rauvola pilot site.

Mission story • **Resist project** • **Resist-project.eu** • **Mission adaptation projects catalogue**

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Ecosystems and nature-based solutions

Nature-based solutions | Urban greening | Renaturalisation

GreenInCities Barcelona: nature-based solutions for urban renewal

Climate shelters, biodiversity and community empowerment at the Besòs River mouth

Climate hazards:

Main themes:

Barcelona, Spain

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Key figures

5
leading cities and
6
replicating

Implementation timeline

4 years
The GreenInCities project spans from January 2024 to December 2027

Budget

EUR 1.1 million
to complete the whole master plan

Solutions

GreenInCities is an EU-funded project deployed across 11 cities of varying sizes and spreading across different climate zones. The project aims to rethink urban spaces to promote social cohesion and environmental integration through nature-based solutions, co-designed with local communities and targeting both human and non-human stakeholders. In Barcelona, the pilot is located at the Besòs River mouth in the municipality of Sant Adrià de Besòs, an area facing historical social segregation, high levels of deprivation, severe climate conditions and an inhospitable environment for non-human life. The proposed intervention seeks to transform this area by creating new wildlife viewpoints, bioswales and a naturalised zone functioning as a climate shelter, prioritising the needs of both human populations – particularly individuals facing social and urban challenges – and non-human species, including Mediterranean river flora, amphibians, reptiles, small birds and butterflies. Some solutions being developed in Barcelona are as follows.

1. **Wildlife viewpoints.**
New observation points designed to bring citizens closer to the local river ecosystem, enabling environmental monitoring and learning about the river mouth's biodiversity.

2. **Naturalised climate shelter area.**
A naturalised zone that provides thermal relief during extreme weather events, mitigating heat islands and increasing available shade, particularly for vulnerable non-human populations. Climate shelters will be developed using the innovative technique of rammed construction, demolition waste and shade provided by increased vegetation.

3. **Bioswales.**
The integration of bioswales creates new habitats and food sources for the local wildlife. Additionally, they allow for water to be retained during periods of extreme rain, reducing flooding and contributing to thermal comfort through evaporation.

4. **Community empowerment through renaturalisation.**
A renaturalisation process of the Sant Adrià de Besòs seafront and Besòs River mouth designed to enhance local residents' engagement and stewardship of the transformed space and reconnect humans with nature. Green practices will be employed to strengthen the relationship between community and nature.



Co-benefits

Economic

The proposed solutions could achieve economic co-benefits by reducing costs during heatwaves, thanks to the mitigation of the urban heat island effect. At the same time, renaturalisation can lower stormwater management expenses through enhanced water infiltration and reduced drainage infrastructure. Furthermore, the creation of public amenities like wildlife viewpoints may stimulate local economic activity through increased visitation and tourism, mirroring outcomes seen in similar leisure and cultural infrastructure projects elsewhere in the GreenInCities network. Community empowerment through co-design may also foster local entrepreneurship and strengthen resilience in a deprived area.

Social

The Barcelona pilot at the Besòs River mouth targets social co-benefits by addressing deprivation and segregation through inclusive renaturalisation. Interventions aim at providing thermal relief during extreme heat for vulnerable populations, directly supporting community well-being. By creating public amenities like wildlife viewpoints,the project fosters local empowerment and engagement, transforming an inhospitable environment into a shared space for residents and biodiversity.

Environmental

The interventions at the Besòs River mouth aim at delivering several environmental co-benefits. The renaturalisation process directly enhances local biodiversity by supporting Mediterranean river flora, amphibians, reptiles, small birds and butterflies, transforming the area into a healthier ecosystem. The creation of a naturalised climate shelter mitigates urban heat islands and increases available shade, providing thermal regulation during extreme weather events. The project also promotes activities compatible with the river mouth ecosystem, reinforcing the ecological integrity of the Besòs riverfront.

Replicability – *Who can use this approach and how*

Replicable approaches for urban green transition

Transferable wildlife viewpoints, bioswales and climate shelters via inclusive co-design

Best suited for

The solutions put forward in Barcelona are best suited for being replicated in river mouth zones facing similar environmental and social challenges, particularly areas with high deprivation, social segregation, severe climate conditions and limited biodiversity habitats, as these mirror the Besòs River mouth context, where interventions are designed to address both human and non-human needs simultaneously.

Stakeholders' role

To replicate this project elsewhere, the co-design protocols for similar interventions recommend involving a multidisciplinary coalition including the local community of all ages, urban planners, architects, designers, botanists, ecologists and local decision-makers. Horizontal governance frameworks further emphasise the necessity of engaging residents, visitors, business owners and other interested populations to ensure inclusive planning and social justice. The non-human voice should also be represented.

Built-in scalable tools

The Barcelona pilot incorporates three core built-in elements that can be replicated in other urban contexts: wildlife viewpoints for wildlife and ecosystem monitoring; bioswales for water management; and the creation of new habitats and a naturalised climate shelter providing thermal relief and habitats during extreme weather events. These elements are designed to be modular and scalable, adaptable to various site sizes and conditions, and are directly transferable to other urban waterfronts, river mouths or degraded public spaces facing similar challenges.

Funding pathways

The GreenInCities project is funded through Horizon Europe grant agreement number 101139730.

Cities – GreenIncities • Barcelona – GreenIncities • The project – GreenIncities • 1.+NEW+SPACE+FUNCTIONS+INTEGRATING+GREEN.pdf • 2.+URBAN+GREEN+ELEMENTS.pdf • 3.+GREEN+PRACTICES.pdf • 4.+HORIZONTAL+GOVERNANCE+SUPPORT+SYSTEMS.pdf • CORDIS EU

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Ecosystems and nature-based solutions

Nature-based solutions | Sustainable water management | Water security

Innovative solutions for water management on Spanish islands

Nature-based, resilient and replicable approaches for islands' water security

Climate hazards:

Main themes:

Canary Islands, and Menorca (Balearic Islands), Spain

Contact: Office International de l'Eau, France (Natalie project coordinator)

Key figures

2 million
people living on the Canary Islands

1.25 million
people living on the Balearic Islands

12 hm^3
of annual groundwater consumption in Menorca

Implementation timeline

2023–2028
Natalie project timeline

Solutions

The Natalie (accelerating and mainstreaming transformative nature-based solutions (NBS) to enhance resilience to climate change for diverse bio-geographical European regions) project's case study on the Spanish archipelagos explores innovative alternative water management solutions designed to strengthen climate resilience on the Canary and Balearic Islands. In these island territories, water scarcity, increasing climate pressures and the need for more robust and adaptive resource management make sustainable water strategies especially important. Through this case study, Natalie has implemented the following solutions.

1. **Bioremediation nature-based solutions.**
Fuerteventura is exploring innovative water management through NBS to treat and reuse waste water while helping restore the natural water cycle at Oasis Wildlife. By using systems such as constructed wetlands and infiltration areas, treated water can be naturally filtered, water quality improved and aquifer recharge supported in the context of chronic water scarcity. Physical, chemical and microbiological parameters, including contaminants and microplastics, are analysed to ensure proper hydraulic operation.

2. **Sustainable urban drainage systems.**
Implemented in Gran Canaria, this integrated approach uses a bioretention system and a filter swale to retain, filter and treat run-off and combined sewer overflows. This solution also reduces the pollutant load reaching the Maspalomas pond, as assessed through an ongoing monitoring programme evaluating the system's performance and effectiveness.

3. **Constructed urban wetland.**
On Tenerife, this solution aims to reduce urban flooding in the La Laguna area through the development of an urban wetland system integrating natural drainage processes for stormwater management. It mitigates flooding by improving stormwater storage, infiltration and controlled drainage, while creating a multifunctional green space that enhances biodiversity and improves air and water quality, contributing to residents' well-being. Integrated hydrological, hydraulic and hydrogeological modelling supported the design.

4. **Managed aquifer recharge.**
On Menorca (Balearic Islands), an alternative approach based on NBS, referred to as managed aquifer recharge (MAR), is being developed to recharge the groundwater body of Addaia by reusing treated water from wastewater effluents discharged into the wetland. The aquifer is being monitored to characterise its current status and to assess the future evolution of water quality and quantity in the area.



Co-benefits

Economic

In water-scarce island regions, managed aquifer recharge, together with reclaimed water reuse, generates important economic co-benefits by improving the efficiency of water management and reducing the costs associated with water treatment, operation and maintenance alongside improved water security. It contributes to diversifying water supply sources and reducing dependence on desalination, long-distance water transfers and emergency drought measures. These approaches help lower operational costs and increase the resilience of strategic sectors such as agriculture, tourism and urban water supply, while promoting a more efficient use of water resources and improving water quality.

Sustainable urban drainage systems reduce pollutant loads in urban run-off, decreasing the need for and costs associated with water treatment. In addition, the use of natural systems for water storage, filtration and regulation can reduce the need for new grey infrastructure and its associated costs.
These actions strengthen the economic resilience of island territories in the face of water scarcity and extreme climate events, while supporting local employment opportunities in areas such as sustainable water management, ecosystem restoration and green innovation.

Social

The Natalie demonstrators generate important social co-benefits by increasing community resilience to water-related risks and improving the quality of urban and natural environments. NBS contribute to reducing population exposure to flooding and improving surface water quality through natural filtration and regulation processes. In addition, the creation and restoration of green infrastructure improves the perception of public spaces, enhances community well-being and provides new recreational and educational areas. These spaces promote environmental awareness, citizen engagement and social acceptance of innovative solutions for more sustainable water management. Aquifer recharge improves the availability and reliability of

groundwater resources and reduce the vulnerability of communities to drought periods and water scarcity and quality issues, contributing to the long-term resilience of water systems and local livelihoods dependent on water resources.

Environmental

The measures implemented through the Natalie pilot projects generate important environmental co-benefits by improving water quality, reducing pollutant loads and easing pressure on overexploited water resources. NBS contribute to ecosystem health improvement through natural filtration and retention processes and biodiversity enhancement. Furthermore, the creation and restoration of aquatic ecosystems and green spaces support ecological functions, increase biodiversity, contribute to carbon storage and help reduce the urban heat island effect. The recovery of groundwater resources improves their long-term availability and increases their resilience to drought periods. It also contributes to reducing the risk of seawater intrusion in vulnerable aquifers. Overall, these solutions reduce the environmental footprint of water management, promote water reuse and circular water approaches and contribute to the creation of more sustainable and climate-resilient island ecosystems while generating multiple ecosystem services for society.

Replicability – *Who can use this approach and how*

Replicating Spanish islands' approach to water resilience

Transferable lessons for water management through nature-based solutions and aquifer recharge

Best suited for

The regions best suited to replicate projects combining treated waste waterreuse, NBS and MAR are water-stressed Mediterranean and semi-arid areas where groundwater depletion, drought and seasonal water scarcity create strong incentives for integrated water management. These include regions with intensive agriculture or tourism and vulnerable aquifers, along with other arid and coastal territories facing similar pressures.

Stakeholders' role

To replicate this project in other regions, it is essential to involve a broad range of stakeholders working in a coordinated way. These typically include public authorities and regulators, water utilities and infrastructure operators, farmers and irrigation organisations, environmental agencies, researchers and technical experts, technology providers, funding bodies, landowners and local communities. Each group plays a distinct role, from planning, permitting, financing and technical design to operation, monitoring and public acceptance. Strong cooperation among these actors is crucial to ensuring that such approaches are technically feasible, environmentally safe, economically viable and socially accepted.

Built-in scalable tools

The demonstrators show several replicable elements centred on integrated water-sensitive urban design. These include the use of NBS to create multifunctional green areas that combine environmental, social and hydraulic functions, the implementation of sustainable urban drainage systems to reduce flood risk while improving water quality, and measures that enhance aquifer recharge by promoting infiltration and retention. Taken together, these elements illustrate an approach that can be transferred to other contexts where climate resilience, water management and the multifunctional use of green space are pursued jointly.

Funding pathways

Natalie's pilots received funding through Horizon Europe, under grant agreement number: 101112859. In addition, the production of cost-saving evidence may generate interest in scaling up these interventions and create new investment opportunities.

Mission story • Natalie • Mission projects catalogue • Fuerteventura • Gran Canaria • Tenerife • Baleares • CORDIS

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Ecosystems and nature-based solutions

Innovative approaches | Collaboration | Scalable

Nature-based solutions driving climate resilience in Skåne, Sweden

Co-designing and testing locally adapted solutions that deliver benefits for people, nature and the economy

Climate hazards:

Main themes:

Skåne, Sweden

Contacts: Project coordination: ART-ER Attractiveness Research Territory, arcadia_project@art-er.it
Local partner: jenny.bengtsson@sbhhub.se

Key figures

90 %
of Lund's wetlands lost over the past

200 years
due to agricultural drainage

150
trees planted in

Malmö
from September to October 2025

Implementation timeline

2024–2028
Arcadia project's timeline

Solutions

The Arcadia adaptation project in Skåne, Sweden, shows how nature-based solutions can turn climate risks into opportunities. Involving three municipalities – Helsingborg, Lund, Malmö – and the Skåne region, the project strengthens resilience to heat, flooding, pollution and drought while delivering strong co-benefits for biodiversity, health and local economies. Three pilot sites are testing scalable approaches across urban and rural landscapes.

1. **Malmö – urban forest in a former ferry terminal.**
In Nyhamnen, a former industrial site is being transformed into a new urban forest and climate hub. Because of contaminated soils, trees are planted in raised steel containers, while drought- and wind-resistant species are tested for future city design. The site also explores floating wetlands and eelgrass restoration to improve water quality. Just 300 metres from the central station, it combines climate adaptation, biodiversity and a new public space in a highly visible urban regeneration project.
2. **Helsingborg – blue–green rural corridors.**
Helsingborg is building ecological corridors linking land and sea to boost biodiversity and strengthen resilience to floods and droughts. Through geographic information system (GIS) mapping and a local water council, landowners, farmers and businesses help identify priority areas. The project is also testing out innovative financing, including biodiversity credits and corporate partnerships. The goal: a scalable implementation plan backed by long-term investment by 2028.
3. **Lund – water resilience at the catchment level.**
Lund is rethinking water management after losing most of its wetlands over the past two centuries. The city is restoring wetlands, expanding rainwater harvesting and redesigning urban spaces with more green and blue infrastructure to reduce flooding and heat stress. Working closely with rural stakeholders, Lund manages water at the catchment level and is developing strategic tools in a new cross-municipal biosphere reserve. The result is a new model where water is treated as a shared resource across the city and countryside. In the new biosphere reserve, Lund is also exploring international biodiversity credit frameworks in collaboration with international experts and the Scanian Landscape Foundation.



Co-benefits

Economic

The Arcadia co-innovation labs in Skåne highlight emerging economic benefits from collaborative nature-based solutions. In Helsingborg, innovative financing models are being explored, including biodiversity credits and corporate contributions, to support blue–green corridors and wetland restoration. This approach helps reduce the financial burden on municipalities while opening new opportunities for private-sector engagement in climate resilience. In Lund, measures such as wetland restoration and rainwater harvesting reduce long-term costs by limiting flood and drought impacts on both urban infrastructure and agriculture.

Social

The Arcadia co-innovation labs deliver strong social co-benefits by embedding nature-based solutions into everyday urban and rural life. In Malmö, a former industrial site is being transformed into an urban forest that improves air quality, reduces heat and creates new public space for recreation and cultural activities. Blue–green corridors further reconnect communities with nature across rural and urban areas. In Lund, the development of a biosphere reserve and catchment-wide water management strengthens education, awareness and cross-sector collaboration. Together, these initiatives enhance well-being, inclusion and social cohesion while building climate resilience.

Environmental

The Arcadia co-innovation labs deliver significant environmental gains through scalable nature-based solutions. Urban forests in Malmö and Helsingborg improve biodiversity, air quality and urban cooling while restoring degraded land. In rural areas, blue–green corridors and wetland restoration enhance habitat connectivity, store water and reduce flood and drought risks, addressing the long-term loss of wetlands in Skåne. Innovations such as floating wetlands and eelgrass restoration further improve water quality and ecosystem health. Across the region, these solutions restore ecosystems, support carbon storage and strengthen climate resilience.

Replicability – *Who can use this approach and how*

From local pilots to regional models: the replication potential of Skåne's Arcadia projects

Lessons from Skåne's Arcadia pilots for regions facing climate, land and water challenges

Best suited for

The Arcadia-led project in Skåne is a replicable model for regions facing climate extremes, polluted land and complex urban–rural water challenges. It is particularly relevant for coastal municipalities, post-industrial sites and agricultural areas exposed to flooding, drought, heat stress and soil degradation. The project demonstrates adaptable solutions such as urban forests on contaminated sites, blue–green corridors and wetland restoration that can be transferred to similar contexts across Europe.

Stakeholders' role

The project brings together municipalities, regional authorities, landowners and farmers, businesses, environmental experts, water coordinators, urban planners and community stakeholders. Arcadia's co-innovation labs also engage GIS specialists, project managers and policy developers to map risks and co-design solutions. Local associations, children, and art and culture creators have also been closely involved in activities conveying and co-creating the environmental and societal significance of nature-based solutions in lab sites. Collaboration is structured through mechanisms such as water councils, business partnerships and landowner dialogues, ensuring integrated urban–rural adaptation.

Built-in scalable tools

The Arcadia-led project in Skåne is designed with scaling up at its core. Co-innovation labs provide structured spaces to develop and test replicable solutions, while GIS-based mapping supports data-driven identification of priority areas for nature-based solutions. Innovative financing approaches, including biodiversity credits and business partnerships, help unlock private investment. Water councils enable cross-sector governance between urban and rural stakeholders. Pilot sites function as demonstration hubs, while knowledge-sharing networks ensure lessons on design, financing and governance are transferable across regions.

Funding pathways

The Arcadia project is funded through the Horizon Europe programme, supporting the development and testing of nature-based solutions across pilot sites. To enhance long-term sustainability, additional funding pathways are being explored, including business contributions such as biodiversity credits and corporate partnerships in Helsingborg. Municipal budgets also play a key role in co-financing pilot implementation and enabling local deployment. In the city of Malmö, implementation of the urban forest was supported by the municipal budget and other external funding.

Arcadia project • Co-innovation lab 1 • Co-innovation lab 2 • Co-innovation lab 3 • Project deliverables • CORDIS

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Ecosystems and nature-based solutions

Wetland restoration | Nature-based solutions | Coastal adaptation

A wetland restoration plan on the Turkish coast

Replicable nature-based solutions for coastal resilience and community livelihoods

Climate hazards:

Main themes:

Izmir, Türkiye

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

The Gediz Delta
is a
Ramsar site

60 km²
of public land in rural and peri-urban areas

Implementation timeline

2023–2028
CARDIMED project timeline

Solutions

To restore degraded coastal wetlands in central Izmir, this demonstration project implements integrated nature-based solutions (NBS) addressing both environmental degradation and socioeconomic challenges. Through ecological restoration, sustainable land management and community-focused practices, the interventions aim to revitalise biodiversity, improve water quality and enhance climate resilience while supporting local livelihoods.
The NBS approach is holistic and adaptive, ensuring long-term sustainability for both nature and people through the following.

1. **Coastal wetland restoration.**
Revitalising degraded coastal wetland habitats by creating a channel and a temporary pond, replanting native vegetation, diverting fresh water and controlling invasive species. This restores natural hydrology and biodiversity, improving flood protection, water quality and climate resilience while supporting local livelihoods.

2. **Riparian buffer areas.**
Establishing vegetated buffer zones around the wetland to enhance ecosystem health and water quality. These act as natural filters, reduce pollution run-off, stabilise soils, diversify habitats and strengthen biodiversity and long-term wetland resilience.

3. **Native vegetation and fauna restoration.**
Replanting indigenous flora and reintroducing key species (including buffaloes) to restore ecological balance and habitat quality. These measures strengthen ecosystem functions and increase resilience to climate change and invasive species.

4. **Sustainable communal grazing practices.**
Promoting controlled livestock grazing to maintain wetland health while supporting local livelihoods. This helps balance ecosystem pressures and improves habitat quality.

5. **Green corridors.**
Creating ecological corridors that connect fragmented habitats, enabling species movement and genetic exchange. These corridors enhance ecosystem resilience while also providing recreational and educational opportunities.



Co-benefits

Economic
The project supports local livelihoods linked to natural resource use while enhancing eco-tourism potential through infrastructure such as walking and cycling paths and birdwatching facilities. Wetland restoration also strengthens coastal protection by reducing the risk of flooding and erosion, contributing to long-term economic resilience.

Social
The interventions improve access to nature and strengthen community engagement through recreational and educational infrastructure, including walking and cycling paths, birdwatching towers and interpretation tools. They also support traditional livelihoods and improve well-being in communities dependent on these ecosystems.

Environmental
The NBS significantly enhance ecosystem health through wetland restoration, native species reintroduction, invasive species control and ecological corridor development. Riparian buffers and freshwater management improve water quality and reduce salinity, while restored wetlands strengthen biodiversity, flood mitigation, erosion control and drought resilience, supporting long-term climate adaptation.

Replicability – *Who can use this approach and how*

Replication potential of Izmir's coastal wetlands restoration interventions

Adaptable nature-based solutions for coastal and peri-urban wetlands

Best suited for

This model is well suited for municipalities, environmental agencies and non-governmental organisations (NGOs) managing degraded coastal or peri-urban wetlands and seeking climate-resilient NBS. Its integrated approach combining wetland restoration, sustainable grazing and eco-tourism infrastructure also makes it relevant for local governments, research institutions and communities dependent on natural resources.

It is particularly applicable in areas facing biodiversity loss, erosion and/or flood risks. Partnerships with wastewater treatment operators and conservation organisations can further enhance scalability and replication across similar coastal ecosystems.

Stakeholders' role

The project has been developed in close collaboration with local authorities and communities whose livelihoods depend directly on natural resources and ecosystem services. This engagement ensures local ownership and alignment with socioeconomic needs. Stakeholder involvement also supports long-term sustainability by integrating local knowledge, operational needs and environmental priorities into project design and implementation.

Built-in upscaling tools

Replicability is supported by flexible NBS and a strong stakeholder engagement framework. The approach is adaptable to different coastal and peri-urban wetland contexts while maintaining core ecological restoration principles.

Monitoring tools such as water sensors and camera traps enable data-driven evaluation and support evidence-based scaling in similar ecosystems.

Funding pathways

This Cardimed demo is primarily funded by the EU Mission on Adaptation to Climate Change. This provides the core financial basis for implementation and monitoring activities. Its focus on local livelihoods and ecosystem restoration also creates opportunities for additional co-funding from municipal and regional authorities, including the Izmir Metropolitan Municipality, by aligning environmental benefits with local development priorities.

Cardimed • Factsheet • Policy briefing • CORDIS

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Health and well-being

Heat mapping I Urban greening I Community well-being

Using nature-based solutions for heat resilience in Zagreb, Croatia

Using heat mapping for urban greening to combat the urban heat island effect

Climate hazards:

Main themes:

Zagreb, Croatia

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Key figures

1
block-level heat map

4 °C
difference within individual block

Implementation timeline

2021–2025

Solutions

During the rebuilding of Zagreb after the 2020 earthquake, innovative approaches were integrated to address not only structural recovery but also urban climate resilience. A key objective was to reduce the urban heat island effect while embedding nature-based solutions into long-term reconstruction planning.

1. **Heat mapping.**
A detailed block-level heat map was developed for Zagreb to better understand spatial temperature variations across the city. The analysis revealed temperature differences of up to 4 °C within short distances, largely driven by the uneven distribution of green infrastructure.

Distinct urban areas showed clear contrasts, with greener zones such as Parc Zrinjevac consistently registering lower temperatures compared to denser, less vegetated areas. This high-resolution data helped identify urban hotspots and provided an evidence base for targeted interventions, linking heat exposure directly to urban form and land use.

2. **Green infrastructure.**
Building on the heat analysis, a pilot urban block was developed to test the integration of green infrastructure into reconstruction planning. Measures included green roofs, green walls, tree canopies and green corridors, designed to reduce heat stress while delivering multiple co-benefits. The pilot served as a demonstration space for evaluating environmental, social and economic impacts, and informed wider city-scale integration of nature-based solutions through Regilience+ and related initiatives such as GreenScape CE and the greening the city initiative.



Co-benefits

Economic

The integration of green infrastructure into Zagreb's reconstruction strategy delivers strong long-term economic returns. Reducing ambient temperatures lowers cooling demand in buildings, leading to significant energy savings during heatwaves. Property values tend to increase in proximity to green spaces, stimulating local investment and urban regeneration. The approach also supports green job creation linked to the planning, construction and maintenance of urban nature-based solutions. In addition, reduced heat-related health costs and lower stress on urban infrastructure translate into savings for public budgets over time.

Social

Nature-based solutions significantly improve urban liveability and public health. Green spaces provide accessible cooling areas during extreme heat, reducing heat stress, particularly for vulnerable groups such as older people and children. They also enhance opportunities for outdoor activity, social interaction and recreation, strengthening community cohesion and reducing social isolation. Importantly, the participatory planning approach used in Zagreb ensures that citizens and stakeholders are actively involved in shaping interventions, strengthening ownership, trust and civic pride, while contributing to more equitable urban development.

Environmental

The expansion of urban greenery delivers multiple environmental gains. It increases urban biodiversity by creating habitats for pollinators, birds and other species adapted to urban ecosystems. Vegetation also acts as a natural carbon sink and improves air quality by filtering pollutants. In addition, green infrastructure enhances water management by reducing surface run-off and limiting erosion during heavy rainfall events. Together, these interventions restore ecological balance within the urban environment and strengthen Zagreb's long-term environmental resilience.

Replicability – *Who can use this approach and how*

A scalable model for heat-proofing urban areas

How this greening approach can be adapted to different regions

Best suited for

This model is particularly relevant for cities facing rising temperatures, strong urban heat island effects and insufficient green infrastructure. It is especially applicable in southern Europe and other regions where heatwaves are becoming more frequent, intense and prolonged, putting pressure on health systems, infrastructure and vulnerable populations.
It is also highly relevant for post-disaster recovery contexts, where reconstruction processes create a rare opportunity to integrate climate resilience from the outset. In such situations, rebuilding becomes a lever not only for recovery but also for long-term urban transformation.

Stakeholders' role

The model is based on a collaborative, multilevel governance approach. Local authorities lead planning and implementation, working closely with the EU Mission on Adaptation to Climate Change to ensure technical robustness and alignment with wider adaptation objectives.
Local stakeholders, including spatial planning departments, citizens, non-governmental organisations and academic institutions, actively contribute to shaping interventions. Their involvement ensures that solutions are context-specific, socially accepted and capable of delivering co-benefits across different groups. This shared governance structure strengthens legitimacy while improving the quality and durability of urban interventions.

Built-in scalable tools

The model is inherently scalable because it starts from a simple but powerful entry point: high-resolution heat mapping. This provides a clear, evidence-based foundation for identifying urban hotspots and prioritising interventions where they are most needed.
Its block-level design allows for gradual expansion rather than large-scale disruption. Cities can begin with pilot neighbourhoods to test and refine solutions before progressively extending interventions across wider urban areas. This phased approach reduces risk, builds local capacity and enables continuous learning.
Because both the diagnostic tool (heat mapping) and the intervention logic (modular greening) are transferable, the model can be adapted to different urban morphologies, governance systems and climate conditions without losing its core effectiveness.

Funding pathways

The model was financed through the Regilience+ project under the EU Mission on Adaptation to Climate Change, demonstrating how EU innovation and adaptation funding can support integrated urban resilience approaches.
Beyond initial project funding, the model is well positioned for replication through a mix of urban development, climate adaptation and cohesion policy instruments. Its clear co-benefits for health, energy efficiency and urban regeneration also make it attractive for blended financing approaches involving public budgets, EU programmes and potential private investment in green infrastructure.

> *'Extreme weather events will be more frequent in the future as the climate is changing. Zagreb has to adapt its processes and infrastructure!.'*
>
> **Tomislav Tomašević, Mayor of the city of Zagreb**

Mission story • **Regilience+** • **CORDIS** • **Making grey cities greener**

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Health and well-being

Early warning systems I One health I Prevention

Preparing Tampere for the health impacts of climate change

Aurora project insights on digital tools, capacity building and climate-health solutions in the boreal zone

Climate hazards:

Main themes:

Tampere, Finland

Contact: Aurora project coordinator, Exus Software Monoprosopi Etairia Periorismenis Evthinis, Greece

Key figures

5
demonstrators and
3
replicators

Implementation timeline

42 months
The Aurora project spans from September 2024 to February 2028

Solutions (1)

The Aurora project is an EU Mission on Adaptation to Climate Change research initiative that aims to enhance resilience against health risks stemming from climate change, with a primary focus on the EU's boreal region. The project seeks to comprehensively monitor and model interconnected climate and epidemiological stressors to provide early warnings, tailored recommendations for adaptation measures and support for informed policymaking, all aimed at safeguarding public health. The project is based on the 'One health' approach, which combines environmental, animal and human health into a single framework. In Tampere, Finland, the solutions put forward are as follows.

(1) Aurora project, 'Aurora', Aurora website, https://www.auroraclima.eu/.
Lithuanian University of Health Sciences, 'Early findings from the AURORA project in fighting the climate effect: Risks of climate change impacts on human health', 23 January 2026, https://doi.org/10.5281/zenodo.18348154.
Lithuanian University of Health Sciences, 'Early findings from the AURORA project in fighting the climate effect: Health systems response to climate change adaptation', 23 January 2026, https://doi.org/10.5281/zenodo.18348056.
Lithuanian University of Health Sciences, 'Early findings from the AURORA project in fighting the climate effect: Potential for climate change mitigation', 22 January 2026, https://doi.org/10.5281/zenodo.18339977.
Aurora project, 'Demo cities', Aurora website, https://www.auroraclima.eu/demo-cities.
City of Tampere, 'Tampere preparing for the health impacts of climate change (AURORA project)', Tampere website, https://www.tampere.fi/en/city-and-decision-making/organisation/tampere-preparing-health-impacts-climate-change-aurora-project.

1. **Digital platform.**
The Aurora digital platform being developed in Tampere integrates health, weather and local community data within the 'one health' framework to provide early warnings and targeted recommendations for protecting public health from climate-related risks. The platform serves as a holistic decision support system that monitors climate stressors, creates climate and epidemiological models, generates forecasts through simulated scenarios, and identifies specific climate change risks and vulnerabilities in the boreal region. The digital platform brings together diverse data sources and allows testing adaptation solutions in virtual simulations, thus enabling informed policymaking, improving health system preparedness and empowering local experts with tools to make smarter decisions that safeguard city residents' health against the impacts of climate change.

2. **Capacity building.**
Training and decision-support tools to make informed decisions that protect public health from climate-related risks are part of the capacity-building programme. Preliminary Aurora findings recommend integrating climate health training into medical and nursing curricula, including frontline workers in resilience planning and emergency response, and providing mental health support for staff. The aim is to ensure that those on the front line of climate-health challenges have the knowledge, skills and tools necessary to anticipate, prepare for and respond effectively to the evolving health impacts of climate change in the boreal region.



Co-benefits

Economic

The Aurora project could potentially lead to efficiencies in healthcare spending. The project's emphasis on early warning and preventative monitoring, especially for heatwaves and infectious diseases, implies a shift from reactive emergency care to proactive management, which broader Aurora findings indicate can optimise resource allocation and reduce mortality. Furthermore, the use of virtual simulations for testing adaptation measures allows for cost-effective planning that avoids the potential financial risks. Consequently, preventing climate-exacerbated chronic conditions through targeted recommendations could reduce long-term treatment burdens on the local healthcare system.

Social

In Tampere, Aurora's focus on protecting at-risk groups, particularly older adults and people with chronic illnesses, alongside its explicit recognition of mental health challenges such as depression and climate anxiety, establishes a foundation for socially equitable climate resilience. Drawing on broader Aurora findings, the project's integration of local community data and its emphasis on citizen engagement suggest potential benefits extending beyond individual health outcomes to include strengthened social cohesion, as communities are better prepared for and protected during climate disruptions. Furthermore, the project's equity-centred approach implies that Tampere's most vulnerable residents stand to benefit from early warnings and targeted recommendations, reducing the social inequalities that climate change typically exacerbates.

Environmental

According to broader findings from the Aurora project, implementing physical adaptation measures aligned with the 'one health' framework could generate significant environmental co-benefits. Since the project combines environmental, animal and human health, actions like vegetation management or stormwater solutions would naturally extend beyond health protection to support biodiversity and air quality. Indeed, nature-based solutions, such as green corridors and wetland restoration, offer co-benefits for pollinators and carbon sinks, offering the opportunity for strengthening environmental resilience in tandem with public health protection.

Replicability – *Who can use this approach and how*

Replicating Aurora

Built-in transfer elements and target stakeholders for broader adoption in comparable boreal cities

Best suited for

Cities or municipalities located in the EU's boreal climate zone facing similar climate-health stressors, such as heatwaves, vector-borne diseases, water quality risks and mental health impacts, would be best suited to replicate Aurora. The project has already been demonstrated in five demo cities, and results are being replicated in three municipalities.

Stakeholders' role

Successful replication requires engaging a similar multistakeholder consortium. In Tampere, core partners include the city of Tampere, Prizztech Ltd., the Finnish Meteorological Institute and Laurea University of Applied Sciences. For other cities, equivalent stakeholders must be present: local government, meteorological or environmental agencies, academic or research institutions and public health professionals. The implementation hub further confirms that epidemiology experts, healthcare professionals, public health agency workers and local municipality workers should all participate to ensure the solution addresses real-world operational needs.

Built-in scalable tools

Aurora's replicability is built into several core elements designed for transfer. The digital platform and its underlying decision support system, including the simulation engine, risk assessment and AI-based recommendation engine, can be adapted to different cities' local data on health, weather and communities. The 'one health' framework provides a transferable methodology integrating environmental, animal and human health. The implementation hub offers a replicable stakeholder engagement model, while the structured demo-to-replicant city approach provides a proven pathway for scaling. Additionally, the project's emphasis on data openness and interoperable surveillance systems ensures that tools and models can be recalibrated for different epidemiological and climate profiles in new regions.

Funding pathways ([2])

Aurora has been funded through the EU Mission on Adaptation to Climate Change under Horizon Europe grant agreement number 101157643.

([2]) European Commission, 'Demonstrating trAnsformative solUtions to empower climate Resilience tOwards impRoved public health stAtus in the EU Boreal Region', European Commission website, https://doi.org/10.3030/101157643.

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Health and well-being

Heat-resilient mobility I Participatory navigation I Climate-adaptive cities

HEAL: smart navigation in Heidelberg's heat action plan

A participatory, data-driven app to protect vulnerable groups from extreme heat in Heidelberg and beyond

Climate hazards:

Main themes:

Heidelberg, Germany

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Key figures

53 °C
surface temperature measured in July 2022

HEAL project
already replicated in two other German cities

Implementation timeline

Since 2022

Solutions

The city developed a **heat action plan (2022)** based on a comprehensive risk assessment of the urban heat island effect. The plan combines prevention, preparedness and long-term adaptation measures to reduce heat stress and strengthen urban resilience.

1. **Short-term measures.**
Heat warnings are issued through a publicly accessible application (app) and website, while clear rules of conduct are provided to increase citizen awareness and preparedness during heatwaves. A 'cool map of Heidelberg' also guides residents by identifying shaded and cool public spaces across the city.

2. **Medium-term measures.**
The city expands public drinking water points, increases the availability of cooling spaces such as libraries and public buildings, and enhances urban shading through tree planting and technical solutions such as de-paving to reduce heat accumulation.

3. **Continuous measures.**
A catalogue of planning and advisory tools supports heat protection and climate adaptation in urban development. Climate-ecological standards are increasingly integrated into construction projects, supported by monitoring systems to track performance. The OASIS programme strengthens systematic heat-risk reduction in urban design, while ongoing research and education activities, particularly in schools, help build long-term awareness and capacity.

4. **HEAL project.**
HEAL is a heat-stress-avoidance navigation app designed to support safe pedestrian movement during extreme heat. It uses real-time sensor data, shadow modelling and citizen input to guide users along cooler, shaded routes while also providing accessibility information. First launched in Heidelberg in 2024 and later expanded to Worms and Walldorf, HEAL demonstrates a scalable approach to urban heat adaptation by combining digital innovation, behavioural change and climate-resilient urban planning that can be replicated across European cities.



Co-benefits

Economic
By proactively planning to reduce heat exposure for vulnerable groups, Heidelberg aims to lower heat-related health risks, potentially easing pressures on healthcare systems. The HEAL navigation app can help in optimising cost-effective heat adaptation by providing data-driven insights for targeted interventions, such as greening and de-sealing high-risk areas.

Social
The HEAL navigation app delivers key social co-benefits by enhancing inclusive mobility for vulnerable groups, such as older people, tourists and those with limited mobility, ensuring safer access to shaded, heat-resilient routes during extreme weather. Through participatory workshops, city walks and community feedback, the project fosters collaborative urban planning while empowering locals to shape adaptation strategies. Beyond mobility, HEAL raises public awareness of heat risks and promotes adaptive behaviours, helping bridge equity gaps in heat exposure across densely built urban areas. By integrating input from schools, networks for older people and civil society, the solution strengthens community resilience and encourages self-help initiatives, making cities more liveable for all.

Environmental
The measures in the Heidelberg heat action plan, such as tree planting to enhance shading and de-paving sealed surfaces, directly deliver environmental and biodiversity co-benefits by reducing urban heat, improving air quality and restoring natural habitats. The HEAL project actively supports and incentivises these efforts by guiding users along shaded, green routes, reinforcing demand for walkable, cooler pathways. By promoting pedestrian mobility through parks and tree-lined areas, the app indirectly encourages urban greening initiatives, reduces reliance on heat-trapping surfaces and aligns with broader sustainability goals, ultimately contributing to a healthier, more resilient urban ecosystem.

Replicability – *Who can use this approach and how*

HEAL's replicability: from local innovation to scalable heat resilience

How participatory design, real-time data and cross-sector collaboration enable scalable solutions

Best suited for

The HEAL app is ideal for replication by municipalities and local governments, particularly in heat-vulnerable cities with dense infrastructure and at-risk populations, alongside climate agencies, urban planners and research partners already implementing heat adaptation strategies. Best suited for collaborative networks with access to real-time data, community engagement tools and participatory planning, it offers a scalable model for cities seeking to integrate data-driven, inclusive mobility solutions into their climate resilience efforts.

Stakeholders' role

Key stakeholders to involve include local municipalities for policy alignment, research institutions for data modelling and heat mapping, and technical partners to ensure real-time functionality. Community groups, particularly networks for older people, schools and non-governmental organisations, are essential for participatory design and testing, as seen in Heidelberg's workshops and city walks. Engaging with health services and funding bodies further supports scalability and long-term implementation.

Built-in scalable tools

The HEAL project enables scaling up through participatory co-design, using workshops and city walks with older people, schools and local groups to tailor the app to new contexts. Its transdisciplinary approach, combining municipal, research and community input, creates a replicable framework, while real-time sensor data and shadow modelling provide adaptable tools for other cities. Its successful transfer to Worms and Walldorf demonstrates its scalability, further supported by alignment with existing heat action plans, allowing integration into broader urban climate strategies.

Funding pathways

The HEAL project is funded by the Baden-Württemberg Foundation as part of the research programme 'Innovations for adaptation to climate change', an interdisciplinary project involving different research institutions from Heidelberg University.

> *'Interdisciplinarity connects experts across fields like geography, computer science, medicine, and the social sciences; transdisciplinarity goes a step further, bridging science with society and practice. To develop practical and effective solutions, it is essential to engage directly with the target groups.'*
>
> **Dr. Kathrin Foshag, senior researcher at TdLab Geography, Heidelberg University.**

Mission story • **HEAL project**

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Health and well-being

Resilience accessibility I Social inclusion I Preparedness planning

Ensuring inclusive climate resilience in Athens, Greece

Making disaster preparedness accessible to all

Climate hazards:

Main themes:

Athens, Greece

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Key figures

20
firefighter training seminar

2
videos for dissemination

1
evacuation exercise

Implementation timeline

2023–2024

Solutions

Athens developed disability-inclusive evacuation drills, embedding the 'leave no one behind' principle into civil protection strategies and fostering a culture of inclusion in disaster preparedness and response.

1. **Evacuation exercise.**
The European Center for Forest Fires in Athens organised an evacuation exercise characterised by a fire scenario simulation with the contribution of the Greek National Confederation of Persons with Disabilities and the Institute of the National Confederation of Persons with Disabilities and Chronic Diseases. Persons with disabilities were involved in the design, planning and execution of this exercise – through their representative organisations – including role playing to ensure that it mirrored real-life scenarios. It brought together representatives from the General Secretariat of Civil Protection, the Hellenic Fire Service, the National Centre for Emergency Care and the disability community, along with academics, scientists and disaster risk experts. This participatory approach strengthened collaboration across sectors and ensured that inclusion was integrated into all stages of emergency planning and response.

2. **Training seminar.**
A training seminar for 20 firefighters on disability management techniques was initiated by the European Centre for Forest Fires and implemented by instructors of the Greek National Confederation of Persons with Disabilities and the Institute of the National Confederation of Persons with Disabilities and Chronic Diseases to complement the evacuation exercise simulation. The seminar also promoted greater awareness and understanding of inclusion principles among first responders, helping to build more equitable and accessible emergency services, based on the United Nations Convention on the Rights of Persons with Disabilities.

3. **Videos.**
Two accessible videos were produced to support public awareness and professional training for inclusive evacuation. One video raised awareness about the rights and needs of persons with disabilities during emergencies, while another summarised disability management techniques developed during the firefighter training seminar. The videos also contributed to promoting a broader culture of inclusion by encouraging accessible communication and inclusive practices among both citizens and emergency professionals.

4. **Policy recommendations.**
Recommendations were developed to ensure the visibility of persons with disabilities during disaster response, along with the aspects to incorporate into inclusive disaster preparedness actions. These recommendations reinforced the importance of mainstreaming inclusion into civil protection policies and preparedness planning at the local level.



Co-benefits

Economic

The economic advantages of Athens' inclusive disaster preparedness extend beyond immediate cost savings to long-term fiscal resilience. By preventing injuries, deaths and property loss, including the personal assistance equipment of those who are often disproportionately affected by disasters, the programme can contribute to the reduction of post-disaster recovery expenses, such as hospitalisation costs and legal liabilities. Inclusive preparedness measures also help avoid the economic costs associated with social exclusion by enabling all members of society to deal more safely and effectively with emergency situations.

Social

These inclusivity measures in Athens deliver transformative social co-benefits by placing equity at the centre of disaster resilience. In doing so, the project gives agency and dignity to persons with disabilities in disaster response, replacing exclusionary practices with tailored evacuation plans, accessible communication and priority support. Such a shift builds trust in public institutions while also strengthening community cohesion by fostering collaboration among diverse groups. This was demonstrated in the evacuation exercise, which brought together diverse interdisciplinary groups from its design to implementation process, breaking down silos that at times exacerbate vulnerability. By embedding inclusive practices into civil protection policies, Athens sets a precedent for systemic change, ensuring that future disasters do not increase inequalities but instead reinforce solidarity, participation, inclusion and collective safety.

Environmental

Environmental co-benefits are indirect. By improving the efficiency of evacuations and reducing road congestion and the need for complex rescue operations, inclusive preparedness enables emergency services to dedicate more resources to disaster containment, such as wildfire suppression, flood response and the protection of natural ecosystems. This allows responders to focus on critical interventions, including efforts to contain uncontrolled wildfire spread and reduce the broader impacts of climate-related hazards. An earlier and more effective response can help limit the impacts of climate-related disasters on the environment while strengthening community-wide awareness, coordination and overall climate resilience.

Replicability – *Who can use this approach and how*

Inclusive resilience replicability: from Athens to the rest of Europe

How to keep accessibility and inclusion at the heart of disaster preparedness

Best suited for

Such models are suited for cities and regions facing high climate-related hazards, such as wildfires, floods and heatwaves, where marginalised groups are disproportionately vulnerable due to aspects such as inaccessible infrastructure or exclusionary emergency protocols. They are particularly relevant for local authorities seeking to embed inclusion and equal access into climate adaptation and civil protection planning.

Stakeholders' role

The success of this approach depends on its multistakeholder model. Persons with disabilities and their representative organisations lead co-design, ensuring solutions reflect real-life needs. Other stakeholders such as representatives from civil protection and emergency care organisations, academics, scientists and disaster risk experts were included in the dialogue. Guidance was also received from European-level actors, such as the ECFF. This collaborative governance approach helps ensure that inclusion is mainstreamed across all levels of preparedness and response.

Built-in scalable tools

This model utilised a participatory co-design approach that allows these actions to be scaled up in other regions while remaining contextually grounded. Additionally, digital dissemination tools such as educational videos allow for easily accessible knowledge, which can aid upscaling. By integrating inclusion principles into training materials and preparedness methodologies, the approach can be more easily adapted and replicated across different European contexts.

Funding pathways

The inclusive climate resilience initiative example from Athens demonstrate a joint effort, funded through EUR-OPA, the Council of Europe and the Ministry for Climate Crisis and Civil Protection, as well as through the voluntary participation of the disability movement's representatives. Stable funding from states, regions and municipalities to all stakeholders involved, particularly to the representative organisations of persons with disabilities, is key.

> *'Through their representative organisations, persons with disabilities, chronic diseases, and their families can lead efforts to ensure equal rights in emergencies, putting the 'nothing about us without us' principle into practice.'*
>
> **Evangelia Kallimani, Deputy Director of the Institute of National Confederation of Persons with Disabilities and Chronic Diseases in Greece**

> *'To cope with emerging risks, disaster plans need to focus on inclusion and ensure no one is left behind. This includes integrating disability perspectives and involving persons with disabilities across all sectors.'*
>
> **Sofia Karma, Director of ECFF, EUR-OPA/Council of Europe and academic staff at the National Technical University of Athens, Greece**

Mission story • **ECFF** • **Publication**

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Health and well-being

Tropical nights I Vulnerable groups I Urban heat island I Green infrastructure I Governance

Heat action planning for cities

A framework for addressing extreme heat: from hazard assessment to coordinated city response

Climate hazards:

Main themes:

Maribor, Slovenia

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Key figures
Hot days expected to double by mid-century
Increase in tropical nights

Implementation timeline
Since 2025

Budget
EUR 275 000
for short-term measures

Solutions

A comprehensive, evidence-based heat action plan that combines nature-based solutions, governance, technology and behavioral change to reduce heat risks and strengthen long-term urban resilience.

1. **Short-term or emergency measures.**
Short-term or emergency measures include immediate actions during heatwaves to protect public health and raise awareness, including the activation of a heat warning system, access to public cooling spaces, temporary shading in outdoor areas and drinking water provision. The city is equipped with 40 existing drinking fountains, and 17 additional ones are planned to be installed in 2026. Targeted guidelines are being implemented to protect vulnerable groups such as older people, children and outdoor workers, with more than 6 000 brochures having been distributed.

2. **Medium-term measures.**
Medium-term measures focus on preparedness and resilience. These include awareness campaigns on heat risks and protective behaviours, and education and training for public authorities, health professionals and community stakeholders to strengthen institutional capacity.

3. **Long-term measures.**
Long-term measures include structural actions to reduce long-term heat exposure, including integrating heat resilience into urban planning, improving building insulation and cooling solutions, and expanding urban greening (tree planting, shading, reducing sealed surfaces). Additional measures include water efficiency, rooftop solar and energy storage, and monitoring heat-related health impacts to inform future policies.

Co-benefits

Economic
The plan contributes to reducing healthcare costs linked to heat-related illnesses while enhancing the attractiveness and competitiveness of cities. It also stimulates innovation and investment in green infrastructure and climate-resilient urban solutions, creating new economic opportunities.

Social
The measures improve public health, well-being and safety, particularly for vulnerable groups such as older people, children and outdoor workers. Through citizen engagement and awareness activities, the plan also strengthens community cohesion and collective preparedness in the face of climate risks.

Environmental
The approach enhances urban biodiversity, improves air quality and reduces the urban heat island effect. Expanded green spaces and increased tree canopy contribute to cooler, healthier urban environments while supporting ecosystem services and long-term climate resilience.

Replicability – *Who can use this approach and how*

Scaling up heat action planning across Europe

The Maribor heat action plan is built for transfer: its modular nature can be replicated across European cities facing increasing heat risks. Its strength lies in a **modular structure**, combining low-cost measures with scalable interventions, and in a **co-design approach** that actively involves local stakeholders.

Best suited for
This approach is well suited to mid-sized cities in temperate and Mediterranean climate zones, where the number and intensity of hot days are increasing. It is especially relevant for cities with vulnerable populations, such as ageing communities or high proportions of outdoor workers, and where heat governance is still emerging or fragmented. The model is highly applicable across central and southern Europe, but can also be adapted to other regions experiencing similar trends.

Stakeholders' role
The plan is built on a multistakeholder governance structure, bringing together a municipal climate or environmental department with key sectors such as public health, education, urban planning and social services. Civil-society organisations play a central role in community outreach and engagement, while the private sector contributes through innovation, service provision and infrastructure solutions. Each role is clearly defined, making the model easily transferable to equivalent institutions in other cities while maintaining flexibility for local adaptation.

Built-in scalable tools
The approach is supported by practical tools and mechanisms that facilitate replication and upscaling. Peer-to-peer exchange enables cities to share experiences, methodologies and lessons learned. The use of open-source communication materials, awareness campaigns and vulnerability mapping methodologies allows other cities to directly reuse and adapt these resources without significant additional investment. The modular structure of the plan also enables cities to start with priority actions and progressively expand their interventions over time.

Funding pathways
The Maribor heat mitigation plan demonstrates how different funding sources can be combined into a coherent financial strategy. It integrates EU funding streams supporting local resilience projects with municipal budget allocations dedicated to implementation and maintenance. This blended approach ensures both initial investment capacity and long-term financial sustainability, while offering a model that other cities can replicate by aligning European, national and local funding opportunities. Initial estimates of costs for long-term measures, including investments in buildings, greening, maintenance, at the time of publication (2026), amount to EUR 253 million. Cost estimates for some of the short-term measures to be started and maintained on a yearly basis amount to EUR 275 000.

> *'Preparing the plan with strong stakeholder engagement gives the plan its relevance and ensures effective implementation.'*
>
> **Vlasta Krmelj, Director, Energy and Climate Agency of Podravje**

EU Covenant of Mayors • Heat action strategy • Mission story • City of Maribor

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Health and well-being

Coastal water quality I Sewer overflows I Pathogen monitoring

Balancing public health and recreation in Barcelona, Spain

Enabling more effective monitoring of coastal water quality when dealing with combined sewer systems

Climate hazards:

Main themes:

Barcelona, Spain

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Key figures

2
digital innovations

Integration of
many
datasets

Implementation timeline

2021–2025
Impetus project timeline

Solutions (1)

The Impetus project develops innovative tools to help European regions better prepare for climate risks. In Barcelona, increasing heavy rainfall and storm surges are causing more frequent combined sewer overflows, where storm water and waste water mix and discharge into coastal waters. To protect public health while keeping beaches open whenever possible, the project developed a predictive model and an early warning system (EWS) that improves the monitoring and management of bathing water quality.

1. **Quantitative microbiological risk assessment model.**
The model combines real-time weather forecasts, sea conditions and sewer overflow data to predict how pathogens spread after overflow events. By considering factors such as water currents, sunlight and temperature, it estimates where and when bathing water may become unsafe. This enables authorities to make faster, evidence-based decisions to protect public health.

2. **Early warning system.**
Building on the quantitative microbiological risk assessment model, the EWS provides timely alerts following sewer overflow events. It helps authorities identify genuine health risks while avoiding unnecessary beach closures, protecting both public health and the local economy.

Co-benefits

Economic

More accurate risk assessments reduce unnecessary beach closures, helping protect tourism revenues and the businesses that depend on coastal visitors. At the same time, the system improves the efficiency of water quality monitoring and helps avoid unnecessary operational and healthcare costs.

Social

The system improves public health by providing timely information on bathing water quality after sewer overflow events. Better communication between authorities and the public increases confidence in coastal recreation while helping residents and visitors make informed decisions during extreme weather events.

Environmental

By improving the monitoring of sewer overflow events, the system supports better protection of coastal ecosystems and more sustainable urban water management. The knowledge generated can also guide long-term measures to reduce marine pollution and strengthen the resilience of coastal environments.

Replicability – *Who can use this approach and how*

Scaling up the monitoring of combined sewer overflows

How predictive tools can improve coastal water management

Best suited for

This model is particularly suitable for densely populated coastal cities with combined sewer systems, which are increasingly affected by heavy rainfall and storm surges. It is especially valuable where tourism and recreational beaches play an important economic role.

Stakeholders' role

Successful implementation requires cooperation between municipalities, water utilities, environmental and public health authorities, researchers and coastal managers. Together they provide the operational, scientific and governance expertise needed to monitor water quality and respond rapidly to pollution events.

Built-in scalable tools

The predictive modelling approach can be adapted to different coastal environments by integrating local weather, hydrological and water quality data. This flexibility makes the system readily transferable to other coastal cities facing similar climate-related water quality challenges.

Funding pathways

The demonstrator was developed through the Horizon Europe-funded Impetus project, as part of the EU Mission on Adaptation to Climate Change. Its results provide a strong evidence base for further investment in digital EWSs, smart water management and climate resilience in coastal cities.

Mission story · **Impetus** · **Mission projects catalogue** · **CORDIS**

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Health and well-being

One health I Monitoring and surveillance I Citizen engagement

Building resilience to emerging disease-transmitting species in Navarra, Spain

A 'one health' approach to climate adaptation and cross-sectoral collaboration in Navarra's integrated strategy for climate change

Climate hazards:

Main themes:

Navarra, Spain

Contact: Miguel Angel Gonzalez Moreno
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Key figures

Multisectoral
collaboration

1 new
invasive mosquito species detected by student-led monitoring

Implementation timeline

2017–2025

Budget

EUR 15.5 million
(approximately EUR 9 million EU-funded)

Solutions (1)

Within Navarra's integrated climate adaptation strategy, two complementary paths of action are focused on reducing the risk of the spread of vector-borne disease through innovative, prevention-oriented and cross-sectoral approaches.

The first is a **cross-sectoral surveillance** network built on a 'one health' approach. It integrates real-time environmental, animal and public health monitoring with joint risk assessment. This system strengthens the ability of authorities to anticipate and quickly respond to outbreak threats linked to climate-sensitive vectors, ensuring that signals from different sectors are combined into a single, actionable picture.

The second is an **early detection system** designed specifically for livestock. A dedicated warning station monitors infected or disease-carrying animals, allowing for rapid identification of risks and preventing the potential escalation into large-scale spread across farms and surrounding areas. This early intervention capacity is key in limiting transmission pathways before they expand.
These systems are supported by a **technical working group** that brings together data, methodologies and risk-based priorities. It defines emergency thresholds, coordinates resources and timelines and ensures consistent communication, including outreach through local media. The group also strengthens coordination across sectors by tracking invasive vectors through shared knowledge and real-time information flows, improving both the speed and the coherence of response.

Co-benefits

Economic
The integration of surveillance and early-warning systems leads to a more efficient use of economic resources. By detecting risks earlier and targeting interventions more precisely, Navarra reduces the costs associated with large-scale outbreaks and avoids unnecessary or delayed responses.

Social
The approach strengthens citizen preparedness and engagement through risk awareness initiatives and citizen science activities. Educational programmes, including active participation from students in monitoring tasks, help build understanding of vector-borne risks while fostering a culture of shared responsibility.

Environmental
By monitoring and controlling vectors such as mosquitoes and ticks, the system also contributes to protecting native ecosystems. This reduces pressure on biodiversity and helps maintain ecological balance, while limiting the environmental impacts associated with uncontrolled disease spread.

Replicability – *Who can use this approach and how*

A transferable 'one health' model for climate-resilient surveillance

How regions can adopt Navarra's cross-sectoral approach to combat vector-borne diseases

Best suited for
This approach is particularly suited to regions where there are gaps between health and environmental monitoring systems, and where climate change is increasing the risk of vector-borne diseases such as those transmitted by mosquitoes or ticks. It is especially relevant in contexts where coordination between public health, veterinary services and environmental authorities is still fragmented.

Stakeholders' role
The system is built on a 'one health' technical working group that ensures integrated action across sectors. It brings together the Institute of Public Health, the Institute of Agri-food Technologies and Infrastructure of Navarra, the Government of Navarra and local communities. This multistakeholder structure enables shared data use, coordinated risk assessment and faster response across institutional boundaries.

Built-in scalable model
The model is designed for easy replication through two key elements: the 'one health' integrated approach and the deployment of early warning stations. Both components are highly transferable and can be adapted to other regions with similar epidemiological and environmental risks, supporting early detection and a coordinated response to outbreaks.

Funding pathways
Scaling up and implementation are supported through a combination of EU funding programmes and regional and government budgets. This blended financing approach helps ensure both initial deployment and the long-term operational sustainability of the system.

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Infrastructure

Compound hazards I Infrastructural resilience I Transnational transport

Assessing the resilience of transnational transport systems across the EU

Identifying infrastructural vulnerabilities of the Trans-European Transport Network and the economic viability of future adaptation measures

Climate hazards:

Main themes:

Trans-European

Contact: Stichting VU (Miraca project coordinator)

Key figures

2
hazards assessed

Multiple
modes of transport

Implementation timeline

2023–2026
Miraca project timeline

Solutions

The multi-hazard infrastructure risk assessment for climate adaptation (Miraca) project, as part of the EU Mission on Adaptation to Climate Change, aims to develop and validate a decision-support toolkit that helps authorities identify climate-risk-prone regions and implement cost-effective adaptation measures to enhance the climate resilience of the EU's critical infrastructure. One of the three Miraca case studies works on adapting the Trans-European Transport Network (TEN-T) to different climate hazards, such as floods and windstorms. The TEN-T is an essential network of different types of transport that extends across the EU, involving railway lines, maritime routes, ports, roads and more. The case study evaluates the network's climate vulnerabilities and how this can be managed through different solutions, including the following.

1. **Identification of vulnerability hotspots.**
Vulnerabilities of the TEN-T to climate hazards are being identified using different methods, along with understanding how adaptation to one hazard can indirectly alter the infrastructure's vulnerability to other hazards. For example, one such technique is the multi-modal approach to network flow allocation. Using this approach, the project can better understand how passengers and goods move across the network and how passages are rerouted when climate disruptions occur. Based on this information, multi-modal transport flow allocation models are being developed.

2. **Economic analysis.**
An economic analysis of windstorm and flood impacts on the TEN-T is being carried out to better understand the financial losses associated with such disruptions.

3. **Pilot adaptation strategy.**
Possible adaptation interventions that can be implemented along the TEN-T will be assessed based on cost–benefit assessments. Those that make most sense economically will be prioritised. This information will then be used to develop a pilot network adaptation strategy for the network, along with policy recommendations for effectively integrating climate risks into transport infrastructure planning.



Co-benefits

Economic

The TEN-T case study implements solutions that focus on the financial losses and economic viability of climate hazards and potential adaptation measures, supporting more efficient adaptation investment in the transport network. It does this by identifying vulnerability hotspots and evaluating possible adaptation measures through cost–benefit assessments. The economic analysis of flood and windstorm impacts help stakeholders estimate the financial consequences of network disruptions, helping decision-makers to prioritise adaptation measures that can give the greatest benefits for the resilience of the EU's transnational systems.

Social

By improving the resilience of the TEN-T to floods and windstorms, among other hazards, the case study contributes to more reliable transport for passengers and goods across the EU. The development of a pilot network adaptation strategy and policy recommendations supports informed decision-making by transport authorities and infrastructure managers, helping maintain connectivity and minimise disruption during extreme weather events. This strengthens the resilience of EU communities in general, ensuring that vital goods and services arrive at the communities that need them while also allowing citizens to move around as needed. This is especially important during times of extreme climate hazards, promoting public safety. Additionally, the unique transnational element of this case study may help foster collaboration across borders.

Environmental

By improving the resilience and continuity of the TEN-T during extreme weather events, the case study can help maintain access for emergency services and support timely responses during climate-related disruptions. This can indirectly reduce the duration and extent of impacts from climate-related hazards by enabling more effective emergency management operations, which may lessen the impacts that would otherwise severely damage surrounding habitats.

Replicability – *Who can use this approach and how*

Scaling up climate resilience for essential transnational transport networks

Using the model to identify hotspots and assess adaptation pathways

Best suited for

This model is best suited for regions with large interconnected and complex transport networks that face increasing risks from climate hazards, such as floods and windstorms. It is particularly relevant for areas where disruptions to individual sections of the network can create wider impacts across the system, impacting passenger mobility and the movement of goods. This approach is applicable to situations where the type of adaptation interventions that can be implemented have not yet been decided and where the costs and benefits of such measures need to be understood before being implemented.

Stakeholders' role

Since it acts at a transnational scale, the case study relies on collaboration with pan-European transport organisations, such as the World Association for Waterborne Transport Infrastructure, the United Nations Economic Commission for Europe and the Forum of European National Highway Research Laboratories. It also collaborates with entities at the EU governance level, such as the Directorate-General for Mobility and Transport, in order to better coordinate such a large-scale operation. Stakeholder input helps identify critical vulnerabilities and informs the assessment of adaptation measures. By combining technical risk assessments with economic analysis, stakeholders can use the results to support climate-informed infrastructure planning and prioritise interventions that improve network resilience.

Built-in scalable tools

The model integrates scalable tools that can be applied across interconnected transport systems by assessing risks at the infrastructure and network levels. The multi-modal transport flow allocation approach helps analyse how passengers and goods move through the TEN-T and how transport flows may change when climate hazards disrupt infrastructure. Combined with vulnerability assessments, economic analysis and cost–benefit evaluations, these tools provide a scalable model for identifying adaptation priorities in other regions facing similar climate-related transport challenges.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Miraca project, as part of the EU Mission on Adaptation to Climate Change.

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Infrastructure

Measure prioritisation I Tool co-design I Vulnerable critical infrastructure

Protecting roads from climate hazards in Troskotovice, Czechia

Using digital tools to prioritise infrastructural adaptation

Climate hazards:

Main themes:

Troskotovice, Czechia

Contact: EU Covenant of Mayors for Climate and Energy
Email: info@eumayors.eu

Key figures

2
structured workshops

0–1
normalised scoring system

Implementation timeline

2024

Solutions

The project in Troskotovice addresses the urgent need for a standardised approach to prioritising road adaptation under increasing climate risks. It uses an iterative, stakeholder-driven process combining data analysis, workshops and pilot testing to support evidence-based decision-making.

1. **Stakeholder involvement for collaborative planning.**
The municipality organised workshops, site visits and consultations with council members, land offices and regional decision-makers. These sessions helped co-develop and refine the prioritisation approach, ensuring its relevance and adaptability beyond the local context.

2. **Data-driven prioritisation tool.**
A digital tool was developed to objectively rank roads based on environmental, social and climate risk indicators. It integrates multiple datasets into a normalised scoring system, allowing for a transparent comparison of roads. Key criteria include usage, readiness for adaptation measures and environmental value.

3. **Pilot application.**
The methodology was tested on 16 selected roads to validate and refine the approach before broader application.

Co-benefits

Economic
The approach improves the efficiency of road maintenance by targeting adaptation investments where they are most needed. This reduces long-term costs by avoiding unnecessary interventions and strengthens the resilience of critical infrastructure supporting agriculture, transport and tourism. More efficient spending also helps stabilise municipal budgets while reducing economic losses from climate-related disruptions.

Social
The project enhances community safety and accessibility by prioritising roads essential for emergency services, school transport and daily mobility. Stakeholder engagement increases transparency and trust in decision-making, giving local stakeholders a direct role in shaping adaptation priorities. Social and cultural uses of roads are also included in the assessment, reinforcing the importance of citizens' needs. Collaboration with neighbouring regions further strengthens shared learning and community resilience.

Environmental
The tool integrates ecological indicators such as biodiversity value, habitats and the presence of protected species to avoid degrading high-value natural areas. By addressing risks such as erosion and run-off, the approach helps reduce sediment pollution and protects local waterways. Over time, this contributes to healthier soils, improved water retention and more climate-resilient landscapes.

Replicability – *Who can use this approach and how*

A scalable model for climate-proofing roads

How this greening approach can be adapted to different regions

Best suited for

This model is particularly well suited for small to medium-sized rural municipalities that lack systematic climate adaptation planning. It helps local authorities with limited budgets prioritise investments in critical infrastructure exposed to climate hazards. While municipalities with existing climate risk data can implement it more quickly, the tool is also flexible enough to support initial data collection and baseline assessment in less-prepared regions.

Stakeholders' role
The approach relies on close collaboration between local and regional stakeholders. Municipal authorities lead the process, working with local stakeholders in Troskotovice and partners across the South Moravian Region to ensure contextual relevance and transferability. Technical experts provide methodological input and review the prioritisation framework, ensuring robustness and credibility.

Built-in scalable tools

The model is designed for easy replication and upscaling. It uses simple Excel-based templates, allowing municipalities to input local data without advanced technical capacity. Indicators and weighting systems can be adapted to local climate risks and policy priorities. The step-by-step pilot testing approach also supports iterative refinement and gradual uptake in other regions.

Funding pathways

The development of this model was supported by the Policy Support Facility under the EU Covenant of Mayors for Climate and Energy, which enables municipalities to access tailored technical assistance for climate and energy planning. This type of targeted EU support is particularly well suited for small and medium-sized local authorities, as it reduces entry barriers to adaptation planning by providing expertise, methodological guidance and structured implementation support rather than requiring large upfront investment.

Mission story • Covenant of Mayors

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Infrastructure

Healthcare I Education I Multi-hazard

Assessing the resilience of healthcare and educational facilities in Central Macedonia, Greece

Understanding the vulnerabilities of healthcare and educational facilities to floods, landslides and earthquakes using a multi-hazard risk assessment

Climate hazards:

Main themes:

Central Macedonia, Greece

Contact: Stichting VU (Miraca project coordinator)

Key figures

3
types of hazards considered

2
types of infrastructure

Implementation timeline

2023–2026
Miraca project timeline

Solutions

The multi-hazard infrastructure risk assessment for climate adaptation (Miraca) project, as part of the EU Mission on Adaptation to Climate Change, aims to develop and validate a decision-support toolkit that helps authorities identify climate-risk-prone regions and implement cost-effective adaptation measures to enhance the climate resilience of the EU's critical infrastructure. One of the three Miraca case studies aims to better understand how vulnerable educational facilities and hospitals are to single and compound hazards, including floods, landslides and earthquakes as standalone hazards or in different combinations, in Central Macedonia. This case study focused on the asset-level vulnerabilities of these facilities, considering both human and economic losses.

1. **Multi-hazard risk assessment.**
An asset-level risk assessment will be developed for both healthcare and educational facilities. To do this, different analyses will be carried out. Preliminary risk calculations and sensitivity analyses for both single and combined hazards will be conducted to create exposure databases for the facilities. Loss maps in terms of both human and economic losses will be created for different return periods (i.e. the average interval between events) and scenarios. Hazard data and models, including hazard models for single- and multi-hazard scenarios and vulnerability functions will be used. Interdependencies with other critical infrastructure, such as road networks, will be taken into account. A Python-based tool will also be developed to help with the risk assessment process.

2. **Interactive viewer.**
An online interactive viewer will be developed to showcase the multi-hazard risk assessment.



Co-benefits

Economic

This multi-hazard risk assessment helps authorities and other actors identify the educational and healthcare facilities most vulnerable to floods, landslides and earthquakes. This will allow them to prioritise adaptation investment where it will have the greatest impact. In this way, by enabling a better understanding of potential economic losses under different hazard scenarios and probability, the case study supports more cost-effective planning. This helps to reduce future disaster-related losses, while also reducing unnecessary spending for ineffective interventions. The consideration of interdependencies with other types of infrastructure also enables authorities to take into account investment in other sectors, which may also ultimately impact the amount of economic losses experienced.

Social

The case study focuses on strengthening the resilience of hospitals and educational facilities. This contributes to maintaining essential services for the public, both during and after floods, landslides and earthquakes. An improved understanding of infrastructural vulnerabilities in these important sectors supports emergency preparedness and informed decision-making, helping authorities better protect communities in hazardous situations and reduce disruptions to healthcare and educational provision. By considering the interdependencies of these sectors on other types of essential infrastructure, authorities will be better equipped to be prepared for different cascading scenarios. Risk data is more accessible and easily understandable thanks to an interactive viewer that showcases the risk assessment, supporting the dissemination of this important information to the decision-makers and stakeholders that need it the most.

Environmental

By helping authorities to better identify locations vulnerable to climate hazards, this case study helps authorities better identify where infrastructure is most vulnerable. This allows for adaptation measures to be targeted where they are most needed, reducing unnecessary interventions and helping to avoid environmental impacts associated with poorly planned and unnecessary infrastructural interventions.

Replicability – *Who can use this approach and how*

Scaling up climate resilience for essential healthcare and educational infrastructure

Using this approach to assess the hazard risks

Best suited for

This model is best suited for regions where healthcare and educational facilities are exposed to hazards such as floods, landslides and earthquakes, both individually and in combination. It is also relevant for regions where infrastructure vulnerabilities are interdependent and impacts are cascading. It is particularly applicable to regional and local authorities seeking to integrate multi-hazard risk assessments into climate adaptation and infrastructure planning.

Stakeholders' role

Successful implementation of this model requires collaboration between regional and local authorities. In this case study, the main collaborating organisations are the local municipalities of northern Greece, the Administrative Region of Central Macedonia and Greece's Ministry for Climate Crisis and Civil Protection. Such actors can be contributors to the approach (such as providing hazard and infrastructural data), end users of the results of the assessment, and users of the interactive digital viewer. End users would employ these results to inform adaptation planning, emergency preparedness and investment decisions.

Built-in scalable tools

The model develops transferable decision-support tools, including Python-based multi-hazard risk assessment tools and an interactive online viewer of the risk assessment results. These digital tools can be adapted to different regions and infrastructural types by incorporating locally available data such as hazard, exposure and risk datasets. This supports the wider uptake of Miraca's approaches across EU regions.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Miraca project as part of the EU Mission on Adaptation to Climate Change.

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Infrastructure

Operational resilience I Health I Horizon Europe

Digital tool for seaports' operational resilience

A Horizon Europe-funded initiative strengthening Mediterranean ports against extreme weather, sea-level rise and operational disruptions through AI-driven tools and stakeholder co-design

Climate hazards:

Main themes:

Piraeus, Greece;
Valencia, Spain;
Limassol, Cyprus

Contact: Arsinoe project coordinator, Panepistimio Thessalias, Greece
Email:

Key figures

Case study
within the
Arsinoe project
TRL 7
real-world validated in the Port of Valencia

Implementation timeline

4 years
ARSINOE project spanned from 2021 to 2025

Solutions

The **Clever Tool** is a digital platform integrating real-time metocean data with historical disruption records to identify climatic thresholds triggering operational and structural failures in ports. It supports early warning, risk anticipation and decision-making for climate-resilient port operations.

1. **Clever Tool platform.**
The platform integrates real-time meteorological and oceanographic data with historical disruption records, identifies climatic thresholds that trigger operational and structural failures and supports proactive operational planning.

2. **AI-driven analytics.**
AI analytics enable predictive risk assessment, allowing port authorities to anticipate and mitigate weather-related disruptions before they occur, improving preparedness and response capacity.

3. **Test-driven development.**
The platform has been developed through iterative test-driven development cycles with multiple rounds of user feedback. It is currently at technology readiness level (TRL) 7 and has been successfully validated in real operational conditions in the Port of Valencia.

4. **Co-design and stakeholder engagement.**
Collaborative development with port operators, meteorological agencies, decision-makers and local communities was prioritised to ensure tool relevance, usability and practical adoption. Future phases include AI enhancements, broader data integration across additional Mediterranean ports and scaling up to include further climate hazard scenarios to strengthen regional resilience across the Mediterranean.



Co-benefits

Economic
The project reduces operational downtime and emergency costs while strengthening port efficiency, reliability and competitiveness across Mediterranean trade and tourism networks.

Social
This project provides direct health protection for port workers by mitigating heat stress risks, reducing heatstroke, fatigue and long-term occupational hazards through evidence-based interventions. The initiative generates additional social co-benefits through its inclusive development process: stakeholder engagement workshops, iterative feedback loops and collaborative tool design strengthen trust, knowledge sharing and collective ownership among workers, unions and local authorities. By embedding participatory practices into implementation, the project fosters lasting capacity building, social cohesion and a culture of proactive risk management.

Environmental
Better prediction of extreme weather events reduces environmental damage to coastal systems and port infrastructure from storms and flooding, allowing for better planning and decision-making, while enabling more sustainable and climate-informed operational planning.



Replicability – *Who can use this approach and how*

Scaling up EU ports' operational resilience

The Clever Tool is designed for easy transfer and upscaling. Its modular, cloud-based architecture adapts to ports of all sizes, integrates with existing systems and has been successfully validated in real-world conditions at TRL 7 in the Port of Valencia.

Best suited for
Coastal ports of all sizes exposed to heatwaves, storm surges and flooding, particularly those with existing digital infrastructure or undergoing modernisation. The approach works best where collaborative governance brings together operational, technical and institutional stakeholders.

Stakeholders' role
The model is built around port authorities as primary users, working alongside meteorological services, local governments, private operators and research institutions. Port workers and unions play a key role by providing operational feedback, ensuring the tool is practical, trusted and widely adopted.

Built-in scalable tools
Scalability is embedded in the design. The modular cloud-based system allows replication across ports, while AI-driven analytics support automated risk assessment. Seamless integration with existing port systems lowers entry barriers, and iterative development ensures continuous improvement and adaptability to new risks and contexts.

Funding pathways
EU funding supports pilot deployment of innovative digital solutions in port resilience. Upscaling is further enabled by integrating the tool into wider Mediterranean infrastructure strategies and by engaging both public and private stakeholders interested in improving operational continuity and climate resilience.

'By integrating real-time metocean data with AI-driven analytics, the Clever Tool transforms how ports prepare for and respond to extreme weather, turning climate vulnerability into operational resilience across the Mediterranean.'

Arsinoe project team, Fundación Valencia Port

Funded by Horizon Europe • **Arsinoe case study** •
Fundación Valenciaport | Puertos, Logística y Transporte • **arsinoe-project.eu**

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Infrastructure

Electricity I Telecommunication I Cascading effects

Assessing the resilience of electricity and telecommunication networks in the Netherlands

Identifying infrastructural vulnerabilities of the Dutch electricity and telecommunication networks to flooding and how disruptions have cascading effects

Climate hazards:

Main themes:

Netherlands

Contact: Stichting VU (Miraca project coordinator)

Key figures

2
types of flood types considered

2
types of critical infrastructure

Implementation timeline

2023–2026
Miraca project timeline

Solutions

The multi-hazard infrastructure risk assessment for climate adaptation (Miraca) project, as part of the EU Mission on Adaptation to Climate Change, aims to develop and validate a decision-support toolkit that helps authorities identify climate-risk-prone regions and implement cost-effective adaptation measures to enhance the climate resilience of the EU's critical infrastructure. One of the three Miraca case studies aims to better understand the risks and impacts of flooding, both from precipitation and overflowing water bodies, on essential electricity and telecommunications. While these networks face pressures to pursue carbon neutrality and meeting growing usage demands, they must also adapt to raising climate risks.

1. **Identification of risks and impacts.**
Research to identify the risks and impacts of climate hazards on electricity and communications infrastructure is being carried out. Researchers and specialist practitioners from both sectors are being engaged to identify the main interdependencies and critical pathways that occur within the telecommunications and electricity networks during flooding events. Other functions and infrastructure that rely on these networks to operate, such as emergency responses and healthcare system continuation, were also considered to properly address the interdependencies of different critical systems.

2. **Identification of adaptation options.**
Based on the information being collected regarding the identification of risks and impacts, as well as on consultations with stakeholders, adaptation measures for these networks are being co-developed. These measures being proposed are categorised as asset-, network- or system-level. Asset-level adaptation focuses on individual infrastructure assets, such as telecom towers. Proposed asset-level measures include asset elevation and wet flood-proofing. Network-level adaptation focuses on the entire electricity or telecommunication networks. Proposed network-level measures include changes in redundancy and network topologies, Lastly, system-level adaptation focuses on maintaining the services these networks provide to society as a whole. Such measures include back-up power, temporary installations and the temporary deployment of equipment to supplement services while permanent repairs are being carried out.



Co-benefits

Economic

This case study supports more effective adaptation of electricity and telecommunications infrastructure by identifying where the infrastructure is most vulnerable to flooding risks. By focusing adaptation efforts where they are needed the most, economic losses are reduced by avoiding costly and unnecessary interventions. This is complemented by a better understanding of how disruptions have cascading effects on dependent systems, enabling operators to prioritise adaptation measures that provide the greatest reduction in service disruption and infrastructure damage. In turn, this allows for the continuation of economically important activities that depend on telecommunications and electricity. By considering indirect impacts and cascading failures across different levels of infrastructure, not just damage to individual assets, the approach supports more informed investment decisions and improves the long-term reliability of critical infrastructure.

Social

Reliable electricity and telecommunications are needed for the provision of essential services to continue during flooding events. By identifying critical interdependencies between infrastructure sectors, the case study helps strengthen the resilience of services that depend on functioning electricity and telecommunications, such as emergency response, healthcare, transport accessibility and public communications. Collaboration and knowledge sharing between infrastructure operators, researchers and specialist practitioners supports coordinated planning and faster recovery, helping communities remain connected and protected during and after extreme weather events.

Environmental

Improving the resilience of these networks reduces the risk of prolonged disruptions that can limit activities such as environmental monitoring. The project also supports the electricity sector's transition towards carbon neutrality by developing strategies that strengthen climate resilience while contributig to the ongoing energy transition.

Replicability – *Who can use this approach and how*

Scaling up climate resilience for essential electricity and telecommunications infrastructure

Using the model to identify hotspots and assess adaptation pathways

Best suited for

This model is best suited for regions where electricity and telecommunication networks are highly interconnected and exposed to flood risks, both pluvial and caused by precipitation. It is particularly relevant for low-lying and flood-prone areas where failures in one type of infrastructure network can cause cascaded impacts in others, disrupting essential services such as healthcare, emergency response and transport. The model is also applicable where operators need to understand dependencies between multiple critical infrastructure systems at different levels (asset, network, system) rather than assessing assets in isolation.

Stakeholders' role

The model relies on close collaboration between electricity and telecommunications operators, researchers and specialist practitioners to identify network interdependencies, existing gaps in flood resilience, and possible adaptation options. Stakeholder consultations help co-develop adaptation measures at asset, network and system levels, ensuring that proposed interventions reflect operational requirements and can allow the infrastructure to maintain essential services during and after flooding.

Built-in scalable tools

The model develops transferable methods for understanding interdependent electricity and telecommunications networks, including how failures propagate between critical infrastructure systems and affect dependent services. By combining interdependency modelling with the co-development of adaptation measures at the asset, network and system levels, the approach provides a framework that can be applied to other regions and infrastructure sectors facing similar flood risks and cascading failures.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Miraca project, as part of the EU Mission on Adaptation to Climate Change.

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Infrastructure

Digital innovation I Infrastructural resilience I Energy networks

Assessing energy resilience in Slovenia

Developing data-backed decision-support tools to strengthen the infrastructural resilience of Slovenia's power and gas networks to landslides and climate-induced flooding

Climate hazards:

Main themes:

Slovenia

Contact: Stichting VU (Miraca project coordinator)

Key figures

1/3
of Slovenia's electricity is generated by hydropower plants

4
data-backed solutions were created to better understand infrastructural risks

Implementation timeline

2023–2026
Miraca project timeline

Solutions

The Miraca (multi-hazard infrastructure risk assessment for climate adaptation) project, as part of the EU Mission on Adaptation to Climate Change, aims to develop and validate a decision-support toolkit that helps authorities identify climate-risk-prone regions and implement cost-effective adaptation measures to enhance the climate resilience of Europe's critical infrastructure. Slovenia faces increasingly frequent extreme weather events, such as droughts and floods, due to climate change, which poses significant risks to its energy systems. The fifth 'use case' of this project focuses on analysing the impact of landslides and climate-change-driven flooding on the reliability of Slovenia's power and gas networks.

1. **Reliability impact assessment report.**
   A comprehensive report was produced on the impacts of landslides and floods on the reliability of Slovenia's gas and power network, using reliability indices to quantify potential disruptions and identify vulnerable points within the network.
2. **Adaptation strategies and recommendations.**
   A set of tailored adaptation strategies and recommendations were developed in collaboration with key stakeholders. Both technical and operational adjustments were considered as measures to mitigate landslide and flooding risks.
3. **Simulation model of climate impacts on energy networks.**
   A simulation was developed to demonstrate the projected impacts of extreme weather on the reliability of Slovenia's energy supply. This simulation tool will be used as a basis for future adaptation actions.
4. **Data-driven insights and decision support.**
   A set of data-driven insights into climate-induced network vulnerabilities were developed. Decision-makers will use this data to assess critical areas and prioritise investments to strengthen the resilience of energy systems.



Co-benefits

Economic

This case study supports Slovenia's economic resilience by identifying vulnerabilities in the country's exposed energy networks. Through climate impact modelling and reliability assessments, these interventions may help infrastructure operators prioritise adaptation investment for the most impacted and critical resource assets. This helps reduce the likelihood of costly service disruptions, emergency repairs and damage to energy infrastructure. By facilitating targeted and cost-effective adaptation measures, the case study contributes to maintaining reliable energy supply, thereby protecting essential economic activities and reducing long-term climate related costs for utilities and society.

Social

The solutions in this study enhanced social resilience by improving the reliability and continuity of essential energy services during, and in the aftermath of, extreme weather events. Reliable power and gas supplies are critical for households, healthcare facilities, businesses and public services, particularly during emergencies and recovery. By identifying high-risk areas and supporting the implementation of adaptation actions, these solutions help reduce the risk of energy outages during these critical moments. This shields citizens from worse climate consequences, strengthening community preparedness and improving public safety in the face of increasing climate hazards.

Environmental

By assessing the impacts of flooding and landslides on energy networks, this study supports the development of measures that reduce infrastructural vulnerability, thereby preventing the environmental consequences associated with infrastructural failures. These include incidents such as fires and the leakage of toxic substances into the surrounding areas. Improved resilience planning can also reduce the need for repeated reconstruction and resource-intensive repairs for this infrastructure, contributing to a more sustainable approach to infrastructural management and supporting broader climate adaptation objectives.

Replicability – *Who can use this approach and how*

Scaling up climate resilience for power and gas infrastructure

Digital and modelling solutions strengthening infrastructural resilience to landslides and flood risks

Best suited for

This model is best suited for regions where critical energy infrastructure is highly exposed to climate-related hazards, such as landslides and flooding. It is particularly relevant for regions that have the political will to implement adaptations but may lack the data required to successfully assess climate risks and prioritise adaptation investments. Understanding such elements beforehand, through modelling and simulations, allows for a data-backed approach with maximum impact and cost-effectiveness on delivery, in both the short and the long term.

Stakeholders' role

The model relies on collaboration among multiple stakeholders. The key stakeholders leading the case study are Elektro-Slovenija (Slovenia's electricity transmission system operator), the Agency for the Cooperation of Energy Regulators and the European Network of Transmission System Operators for Electricity. Aside from this, many of the solutions implemented were co-developed with other stakeholders, such as policymakers and researchers.

Built-in scalable tools

The model incorporates scalable tools that can be transferred and adapted to other regions and infrastructure systems. These include digital tools such as hazard modelling, infrastructure vulnerability assessments and reliability analysis. Forming a Miraca 'toolkit', these tools allow stakeholders to assess risks and compare adaptation measures under different climate scenarios. This modular structure can be replicated across different geographical contexts and infrastructure sectors using different datasets and focal points.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Miraca project, as part of the EU Mission on Adaptation to Climate Change.

Miraca • **Miraca UC3** • **CORDIS**

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Infrastructure

Compound hazards I Infrastructural resilience I Road networks

Assessing road network resilience in Catalonia, Spain

Developing data-backed risk assessments of road networks vulnerable to compound hazards and using them to evaluate adaptation options

Climate hazards:

Main themes:

Catalonia, Spain

Contact: Stichting VU (Miraca project coordinator)

Key figures

4
hazards assessed

4
road classes included

Implementation timeline

2023–2026
Miraca project timeline

Solutions

In recent years, Catalonia has been experiencing more prolonged and intense drought periods. These conditions bring with them a higher risk of wildfires, which are a major threat to regional road networks. The Miraca (multi-hazard infrastructure risk assessment for climate adaptation) project, as part of the EU Mission on Adaptation to Climate Change, aims to develop and validate a decision-support toolkit that helps authorities identify climate-risk-prone regions and implement cost-effective adaptation measures to enhance the climate resilience of the EU's critical infrastructure. Miraca's second use case addresses the impacts of drought, heatwave and wildfire compound hazards on road networks in the Catalonia region.

1. **Risk assessment.**
A risk assessment is being carried out on the vulnerabilities of Catalonia's road network to those compound hazards. Single hazard indicators are selected to start with; these indicators are combined with landscape information, such as vegetation presence, to consider both climatic conditions and the presence of biomass. Consultations with stakeholders, such as infrastructural managers, are carried out to understand gaps in existing wildfire risk assessments. An exposure model will also be developed, including Catalonia's highways and primary, secondary and small roads.

2. **Adaptation options.**
The results of the risk assessment will be used to assess possible adaptation options, particularly in terms of where they should be implemented along the road networks. Living labs will be organised with local stakeholders, particularly within the tourism and forestry sectors, to discuss these options and how they can be implemented at the local level.



Co-benefits

Economic

The Catalonia case study supports more efficient investment in road infrastructure adaptation by identifying which sections of the road network are most exposed to the combined effects of drought, heatwaves and wildfires. The resulting risk assessments and exposure models will allow actors such as infrastructure managers and local authorities to prioritise adaptation measures in locations where they are expected to provide the greatest reduction in climate risk. This, in turn, will help to minimise service disruptions to economically important transport routes, often used for the movement of both goods and tourism.

Social

The solutions implemented in this use case strengthen collaboration between different actors through engagement and outreach activities such as stakeholder consultations and living labs. The actors involved include infrastructure managers, civil protection agencies, local authorities and local experts, ensuring that information and perspectives from different types of road network stakeholders is collected and considered. By identifying gaps in existing wildfire risk assessments and supporting the co-development of tailored adaptation measures, these activities also help protect local communities by contributing to safer and more reliable transport during climate-related emergencies.

Environmental

This case study combines drought, heatwave and wildfire indicators with landscape characteristics to better identify where climate and environmental conditions increase fire risk. This integrated approach supports adaptation measures that consider both transport infrastructure and the surrounding landscape, improving wildfire risk management that will indirectly protect not only the road network but also the habitats and landscapes that surround them.

Replicability – *Who can use this approach and how*

Scaling up climate resilience for essential road networks

Collaborative assessment solutions strengthening infrastructural resilience to heatwaves, droughts and wildfires

Best suited for

This model is best suited for regions where transport infrastructure is increasingly exposed to the combined impacts of droughts, heatwaves and wildfires. The approach is particularly applicable to road networks that pass through, or are located near, fire-prone landscapes, where vegetation and changing climate conditions are putting this infrastructure at risk. It would also benefit such regions where road transport supports economically important sectors like tourism. It is a multi-hazard approach that can support adaptation planning in regions facing similar compound climate hazards.

Stakeholders' role

The case study relies on close collaboration with infrastructure managers and other regional stakeholders throughout the assessment and implementation process. Stakeholder consultations are used to identify gaps in existing wildfire risk assessments, while living labs involving the forestry and tourism sectors support the discussion, evaluation and implementation of adaptation options. This participatory approach ensures that adaptation measures reflect local knowledge and operational needs.

Built-in scalable tools

The Catalonia case study uses a transferable methodology that combines hazard indicators with landscape information, such as vegetation and biomass, to assess compound climate risks. An exposure model covering highways and primary and secondary roads enables infrastructure managers to identify vulnerable network sections and evaluate adaptation options. Because the methodology is based on hazard, exposure and stakeholder-informed risk assessment, it can be adapted for application in other regions facing similar climate risks.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Miraca project, as part of the EU Mission on Adaptation to Climate Change.

Miraca • **Miraca UC2** • **CORDIS**

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Infrastructure

Digital tools I Nature-based solutions

Digitalised nature-based solutions to help protect water infrastructure on La Palma, Canary Islands

Integrating digital mapping and nature-based solutions for climate resilient water management

Climate hazards:

Main themes:

La Palma, Canary Islands, Spain

Contact: Genesis project coordinator, Agencia Estatal Consejo Superior de Investigaciones Cientificas, Spain

Key figures

162
galleries

75
water wells and

150 springs

75.31 hm³/y
total annual water flow

Implementation timeline

4 years
The GENESIS project spans from 2024 to 2028

Solutions[1]

The La Palma Deep Demonstrator is a pilot site of the Genesis project on La Palma, Canary Islands, Spain. It is designed to test how digitalised nature-based solutions (NBS) can help protect water infrastructure and groundwater resources while improving the island's resilience to climate and environmental pressures. It does so by delivering a digital twin of the island's hydraulic system, collaborating with several stakeholders from the Genesis Consortium. The solutions put forward are as follows.

1. **Installation of water gates.**
Water gates are installed in the section of the underground galleries connecting the volcanic dykes that compartmentalise the groundwater table. Geophysical surveys are carried out to choose the most suitable dykes on which to install the gates, based on their thickness and lateral continuity. This solution allows for more efficient control of the water extraction flow, and its impacts will be evaluated and quantified using a 3D hydrogeological model.

2. **3D mapping of the underground gallery network.**
Comprehensive 3D mapping is carried out to develop a hydrogeological model in order to assess the climate-resilient impacts of the galleries on the groundwater flow management.

3. **Implementing three monitoring wells.**
Three wells for monitoring the aquifer's hydraulic parameters will be installed in the identified optimal drilling sites.

4. **Implementing a nature-based infiltration system.**
Implemented at the wastewater treatment plant, these are soil-aquifer-treatment-type (SAT) interventions based on multipurpose nature-based solutions (NBS) designed to address several challenges at once: reducing the risk of groundwater and marine water contamination while also mitigating flooding. Geological and geophysical studies are being carried out to understand how water infiltrates the area, while boreholes and sensors are being used to monitor and verify the performance of the NBS. The results will help refine the digital twin modelling during and after the pilot phase.

Co-benefits

Economic

Using volcanic dykes for groundwater regulation can generate important economic co-benefits by acting as natural underground barriers that store and slow groundwater; gated galleries allow for relatively efficient and low-energy extraction, reducing operational costs. When combined with NBS to prevent contamination and wastewater disposal, they can also help avoid expensive water treatment and aquifer remediation costs. Together, these approaches strengthen resilience by securing more reliable water supplies for agriculture and communities during dry periods, reducing losses linked to drought and water scarcity, and resource-efficient wastewater and water management. They also create local economic opportunities through jobs in ecosystem restoration, monitoring, sustainable farming and water management.

Social

SAT-type NBS at wastewater treatment plants can generate important social co-benefits by improving public health, reducing pollution exposure, lowering flood risks and creating greener, more pleasant local environments. At the same time, the digital twin of underground water networks adds social value by improving water security, supporting drought and flood preparedness, enabling more transparent and fairer water allocation and strengthening governance through better data and evidence-based decision-making.

Environmental

SAT-type NBS at wastewater treatment plants can deliver environmental co-benefits by using soil-aquifer natural processes to further polish treated water, supporting groundwater recharge. When combined with the digital twin of underground water networks, these systems can also improve the monitoring and management of subsurface water flows, helping operators detect inefficiencies, optimise infiltration and recovery and better protect groundwater quality, preserving the long-term value of groundwater as a strategic natural asset. Together, they can strengthen water reuse and aquifer resilience.

Replicability – *Who can use this approach and how*

Replicating the approach: digital twins and nature-based solutions

How Genesis's integrated approach can be adapted to strengthen aquifer recharge and circular water management elsewhere

Best suited for

The organisations best suited to replicate this SAT-based, digitally supported solution are water utilities, river basin authorities, island and regional governments and research-utility consortia operating in water-stressed, climate-vulnerable areas. These actors are particularly well placed where there is pressure on water resources, exposure to drought, heat, flooding or groundwater degradation and a clear need for wastewater reuse and managed aquifer recharge. Replication is most promising in territories such as islands, coastal zones, volcanic regions and other drought-prone areas, especially where organisations have access to hydrogeological expertise, operational water management capacity, and sufficient digital capability to deploy and use tools such as digital twins.

Stakeholders' role

Replicating this project should involve a broad mix of stakeholder categories to ensure technical feasibility, regulatory compliance and local acceptance. Key groups include public authorities and water management bodies, which provide planning, permitting and oversight; farmers and agricultural organisations, as major end users of reclaimed water; research and academic institutions, which support technical design, monitoring and innovation; businesses and industry, including water utilities, engineering firms and technology providers, which help deliver infrastructure and operational solutions; civil-society stakeholders such as non-governmental organisations and community associations, which can strengthen public engagement and environmental stewardship; and local communities, whose participation is essential for trust, acceptance and long-term success.

Built-in scalable tools

Replicable elements of the project include the use of digital mapping and spatial data tools to support evidence-based planning and decision-making. Another key transferable element is the integration of NBS for wastewater treatment, which use natural processes to improve water quality while also delivering wider environmental benefits.

Funding pathways

The Genesis project has received funding from the EU's Horizon Europe research and innovation programme under grant agreement number 101157447.

La Palma Deep Demonstrator – Genesis

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Infrastructure

Nature-based solutions I Urban greening I Nature restoration

Med-IREN's nature-based solutions in Larnaka, Cyprus

Nature-based solutions, nature restoration and soil unsealing for enhancing climate resilience

Climate hazards:

Main themes:

Larnaka, Cyprus

Contact: Med-IREN project coordinator,
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Key figures

40 °C
summer temperature, recorded increase in number of tropical nights

Wetland
4
salt lakes

Implementation timeline

4 years:
The MED-IREN project spans from 2024 to 2028

Budget

EUR 80 000
for data collection

Solutions

The Med-IREN (Mediterranean critical infrastructure resilience engineering with nature-based solutions) project in Larnaka, Cyprus, aims at implementing nature-based solutions (NBS) and blue–green infrastructure to make the city more resilient to urban flooding, extreme heat and ecological degradation. It combines water-sensitive urban design with landscape restoration to improve how the city manages storm water, to cool public space and strengthen local biodiversity. The solutions envisioned in this project are as follows.

1. **Promotion of permeable materials.**
Densely built urban areas are prone to flash floods. To reduce the risk of flooding, the project envisions replacing impermeable surfaces with permeable materials, such as pervious asphalt and permeable paving.

2. **Urban greenery.**
The project aims at identifying areas within the city to implement blue–green infrastructure, such as rain gardens and urban green areas and corridors. Thermal and lidar drone imagery will be used to map and rank areas with greater thermal discomfort, therefore more suited for implementation. Such NBS are expected to increase the infiltration capacity and reduce the impacts of extreme heat and the urban heat island effect while also enhancing the urban ecosystem.

3. **Flood monitoring.**
The project will install a hydrometric station on the Kamares River, at a location where the river passes beneath the road network through a culvert. The Kamares area has already been identified by the Water Development Department as an 'area of potential significant flood risk', under the implementation of the EU Floods Directive (2007/60/EC) in Cyprus. The project aims to collect data on river flow, water levels and flood response during extreme rainfall events to design the most suitable NBS. These interventions are expected to reduce water velocity and increase soil permeability, while the vegetated riverbanks are expected to be less prone to erosion and improve riverine ecosystems. This will reduce the downstream flood risk by restoring the upstream riverbanks with the proper material and vegetation, focusing on un-channelised sections of the river.



Co-benefits

Economic

The project's nature-based solutions aim to deliver clear economic co-benefits by reducing flood and heat risks in areas close to vulnerable groups, safeguarding key road networks and easing pressure on stormwater systems. These measures aim at lowering the risks of costly damage to public assets. Over time, this strengthens business continuity, supports social and economic activity and contributes to greater long-term economic stability for the city.

Social

The Med-IREN project in Larnaka is expected to deliver important social co-benefits by creating greener and more attractive public spaces, improving residents' quality of life and strengthening links between people and the coastal environment. Measures such as urban greening and ecosystem restoration can support health and well-being, provide places for recreation and social interaction and raise awareness of nature and climate resilience among local communities. By improving everyday urban spaces while addressing environmental pressures, the project can also help make the city more liveable and inclusive for residents and visitors alike.

Environmental

The Larnaka NBS project delivers several environmental co-benefits through its blue–green infrastructure approach. By expanding and restoring urban green spaces, it can support biodiversity by creating and improving habitats for plants and animals. Its use of permeable surfaces, vegetation and water-sensitive design also strengthens stormwater management, helping to retain and absorb rainfall and reduce run-off and flood risk. Additional vegetation contributes to urban cooling by providing shade and evapotranspiration while also helping to improve air quality through the capture of certain air pollutants. In addition, green infrastructure supports carbon sequestration in soils through plant growth while also protecting soil by reducing erosion and improving infiltration. Taken together, these measures can enhance overall ecosystem resilience, making the urban environment better able to cope with heat, heavy rainfall and other climate-related pressures.

Replicability – *Who can use this approach and how*

Replicating Med-IREN's holistic approach to urban climate resilience

A transferable nature-based solutions model for tackling heat, flooding and biodiversity loss through integrated urban planning

Best suited for

The Med-IREN project in Larnaka s best suited for replication by urban municipalities facing growing risks from flooding, heat and environmental degradation, especially those with dense built-up areas and limited green space. It is particularly relevant for local authorities, city planners and environmental agencies seeking cost-effective ways to strengthen climate resilience through blue–green infrastructure while also improving biodiversity, public spaces and quality of life. Cities in the Mediterranean and other climate-vulnerable regions with similar water scarcity, heat stress and rapid urbanisation challenges would be especially well suited to adapting this approach.

Stakeholders' role

Replicating the NBS in Larnaka requires close collaboration between municipal authorities, city planners and urban designers, environmental agencies, and public–private partnerships. Municipal authorities can contribute through urban planning, public works, drainage, parks and climate adaptation. City planners and urban designers can support the integration of blue–green infrastructure. Environmental agencies can provide expertise in biodiversity, water management, ecosystem protection and permitting. Public–private partnerships can help with financing, implementation, maintenance and innovation. Additional stakeholders may include water utilities, local communities, academic experts and private developers.

Built-in scalable tools

The Larnaka NBS project is based on a highly replicable approach for other cities, centred on pilot interventions that test blue–green infrastructure in dense urban areas and combine flood resilience with wider urban benefits. The project applies nature-based measures to improve stormwater management while also contributing to biodiversity, heat mitigation and public space quality. Its replicable value lies the use of pilot sites to demonstrate solutions before broader uptake and collaboration between municipal authorities and project partners.

Funding pathways

The Med-IREN project is financed through the Horizon Europe programme, under grant agreement 101157707.

Larnaka, Cyprus · Med-IREN · CORDIS EU

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Infrastructure

Network leakage I Digital twins I Smart metering

Digital transformation in water management

Best practices and innovative technologies adopted by Apulia's water operator to preserve water resources and boost climate resilience

Climate hazards:

Main themes:

Apulia, Italy

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Key figures

60 %
of drinking water supplied by reservoirs

33 000 km
of water and sewage infrastructure monitored

Implementation timeline

Since 2022

Budget

EUR 2 million + 15 million + 30 million

Solutions

Acquedotto Pugliese's digital transformation, the centrepiece of its EUR 2 billion 2022–2026 business plan, shifts water management from a reactive to a predictive approach, combining advanced monitoring, smart detection and data-driven operations.

1. **Control room (launched in 2024).** It is the new 'digital brain' that enables real-time monitoring and supervision of water and sewerage infrastructure. Using the network's digital twin, it simulates failure scenarios and optimises the management of water districts.
2. **Noise loggers, hydrophones and SmartBall.** Around 20 000 noise loggers deployed across approximately 4 000 km of network record acoustic signals at night to detect leaks. Hydrophones and SmartBall technologies are used to pinpoint exact fault locations on major pipelines.

3. **Smart meters (launched in 2021).**
Italy's largest smart metering project, with over 1 million mechanical meters under replacement by electronic devices transmitting through LoRaWAN protocol daily consumption data via a dedicated digital platform.

4. **Waste water reuse.**
Building on nine existing reuse facilities, 68 additional wastewater treatment plants for agricultural reuse are planned, potentially saving up to 130 million cubic metres of fresh water per year.

5. **District metering and pressure control.**
District metering areas divide the network into smaller zones for easier monitoring. Pressure-reducing valves stabilise pressure, reduce stress on ageing pipelines and limit water losses. The network rehabilitation project (2022–2024) included the replacement of water mains, the installation of district metering systems, and pressure management in 21 of the 260 municipalities served by Acquedotto Pugliese; currently, the project is being extended to 94 more municipalities.

Co-benefits

Economic
The reduction of water losses and improved leak detection significantly lower operational and emergency intervention costs, increasing overall efficiency of the water system. By ensuring a more reliable water supply, the initiative strengthens the competitiveness of key economic sectors such as agriculture and tourism, which are highly dependent on water availability, particularly during dry periods. In addition, the large-scale deployment of digitalisation supports innovation, creates demand for skilled jobs and positions the region as a leader in smart water management.

Social
The system improves the reliability and continuity of water supply for both households and businesses, reducing the risk of restrictions or shortages during peak demand periods, especially in summer. Enhanced monitoring and faster response times increase service quality and user trust. More efficient water management also contributes to greater equity in access to water resources, while supporting long-term water security for local communities.

Environmental
By reducing leakage and promoting wastewater reuse, the system significantly decreases pressure on natural water resources, particularly groundwater and aquifers. The potential reuse of up to 130 million m^3 of water per year contributes to a more circular water economy. In parallel, reduced pumping and distribution losses lead to lower energy consumption and associated emissions, supporting climate mitigation efforts while strengthening overall ecosystem resilience.

Replicability – *Who can use this approach and how*

Scaling up digital water management across Europe

The Acquedotto Pugliese model is designed for its transfer and adaptation across different contexts. Its strength lies in a modular and scalable approach, allowing utilities to progressively transition from reactive to predictive water management. Operators can begin with targeted interventions such as noise loggers or smart meters and gradually scale up towards integrated systems, including digital twins and advanced network optimisation tools.

Best suited for

This approach is particularly suited to water utilities in water-stressed Mediterranean and semi-arid regions, especially where infrastructure is ageing, leakage rates are high and demand from sectors such as agriculture and tourism is increasing. It is also relevant for utilities seeking to modernise operations through digitalisation while improving efficiency and resilience.

Stakeholders' role

The model is based on a multilevel governance and delivery structure, led by a public water utility and supported by technology providers, municipalities, national regulators and EU funding bodies. It demonstrates that public operators can successfully lead large-scale digital transformation while leveraging external expertise and financing mechanisms.

Built-in scalable tools

A key feature of the approach is the full modularity of technologies. Tools such as noise loggers, smart meters, district metering areas and digital twins can be deployed independently or combined depending on local needs and resources. Continuous real-time data collection enables utilities to prioritise interventions and optimise investments, ensuring that actions deliver maximum impact over time.

Funding pathways

The model relies on a blended financing approach, combining EU cohesion funds, national recovery instruments such as the Recovery Resilience Fund, programmes like that for the environment and climate action and public–private partnerships. This flexible mix allows replication at different scales, from pilot projects to full network digitalisation.

> *'Operating in one of Europe's most water-stressed regions, we chose to respond not with emergency, but with innovation. Digital technologies have turned vulnerability into resilience – making water a strategic asset for Puglia's sustainable future.'*
>
> **Professor Domenico Laforgia, President of Acquedotto Pugliese**

Mission story • Mission story factsheet • Acquedotto Pugliese

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Infrastructure

Adaptive infrastructure I Capacity building I EU alignment

Climate-proofing transport infrastructure in Poland

Strengthening resilience in EU-funded projects through adaptive design and awareness

Climate hazards: **Main themes:**

Poland

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Key figures

1
expert group

2
climate-proofing phases

Implementation timeline

2021–2027

Solutions

The Polish Centre for EU Transport Projects (CEUPT) acts as an intermediate body, managing EU cohesion policy, while also supporting the implementation of other EU-funded transport programmes. These funding streams require that all long-term infrastructure projects (minimum duration of five years) integrate climate resilience as a core requirement. The CEUPT therefore works to strengthen climate-proofing in EU-funded transport infrastructure through technical analysis, capacity building and awareness-raising.

1. **Climate-proofing analysis.**
The CEUPT implements a thorough approach to assess climate-proofing in the context of transport infrastructure, ranging from the local to the national level. This climate-proofing method follows the European Commission's technical guidance on climate proofing (2021), which first screens a project's exposure and vulnerability to climate hazards, then conducts detailed risk analysis for medium- and high-risk events in order to guide adaptation measures that improve infrastructure resilience and long-term economic viability. A practical example is the reconstruction of the Rzeszów railway station in Poland, where such a climate analysis introduced measures such as biodiverse plantings for better water retention and extreme-weather monitoring, improving the station's resilience even after construction had begun.

2. **Capacity building.**
The CEUPT, through its Environmental Protection Unit and Climate Adaptation Expert Team, raises awareness and provides practical support to developers in terms of project climate-proofing. Resources available include an online knowledge base with EU-aligned guidelines, climate data sources and examples of adaptation measures applicable to transport projects. These resources are complemented by workshops and training sessions organised by the CEUPT.

Co-benefits

Economic

Climate-proofing transport infrastructure in Poland generates long-term cost savings by reducing damage and disruption from extreme weather events. It also lowers maintenance costs and improves system reliability.
More resilient transport networks reduce costly interruptions such as flooded roads or heat-affected rail systems, which can significantly disrupt regional economies. In addition, aligning projects with EU funding requirements (Cohesion Fund and Recovery and Resilience Facility) helps ensure continued access to financial support, strengthening overall economic stability.

Social

Climate-resilient transport infrastructure improves public safety, mobility and quality of life. By reducing disruptions from floods or heatwaves, it ensures continued access to essential services, including healthcare, education and employment, particularly for vulnerable communities.
Examples include the introduction of street-tree planting along roads and public transport corridors, as well as the redesign of streets and public squares to incorporate blue–green infrastructure. In Gdańsk, the transformation of streets into shared public spaces (woonerfs) with rain gardens and new vegetation has improved pedestrian safety, enhanced neighbourhood attractiveness and created spaces for social interaction while also strengthening stormwater management. In Warsaw and other Polish cities, the replacement of selected parking areas with vegetated areas and trees has contributed to cooler and more livable urban environments, improving residents' well-being, public health and the overall quality of urban space.

Environmental

Designing resilient infrastructure in Poland is combined with introducing greenery and nature-based solutions – where possible. For example, integrating permeable pavements, roadside vegetation, bioswales and rain gardens into roads and parking areas can reduce surface run-off, enhance stormwater retention, mitigate urban heat island effects and improve local biodiversity.
Such measures (e.g. native and biodiverse planting beds in the city centre and the development of green tram tracks and flower meadows along transport corridors) absorb and retain rainwater, reduce temperatures during heatwaves, improve air quality and create more attractive and ecologically valuable public spaces.

Replicability – *Who can use this approach and how*

A scalable model for climate-proofing transport projects

How this climate-proofing approach can be adapted to different regions

Best suited for

The model is particularly suitable for regions facing increasing climate risks, especially those with ageing or vulnerable transport infrastructure and exposed to hazards such as flooding, extreme heat and storm-related events. It is especially relevant for EU Member States and countries accessing EU funding, where climate resilience is a mandatory requirement in the assessment of infrastructure projects.

Stakeholders' role

Successful replication relies on a multilevel governance model that brings together national, regional and local stakeholders. The European Commission is responsible for developing and updating the relevant regulatory framework, while national or EU-linked implementation bodies such as the CEUPT ensure policy application, compliance checks and technical support. Project developers, including engineers and contractors, are responsible for translating climate-proofing requirements into practice during project design and implementation. Other stakeholders involved in projects also benefit from awareness-raising and capacity-building activities, which help strengthen the understanding and uptake of climate resilience principles across the sector.

Built-in scalable tools

The scalability of this approach is ensured through several embedded mechanisms. Climate risk analysis is structured in phases, allowing regions to prioritise the most exposed infrastructure first and progressively extend adaptation measures over time. Open-access resources, such as the CEUPT's online knowledge base, support low-cost dissemination of technical guidance, data sources and best practices. Completed projects also function as replicable reference cases, demonstrating practical and cost-effective solutions that can be transferred to other contexts. In addition, training programmes strengthen institutional and technical capacity, enabling consistent application of climate-proofing approaches beyond initial pilot projects.

Funding pathways

This model is supported by EU and national funding instruments, including the programme 'European funds for infrastructure, climate, environment 2021–2027' and the national recovery and resilience plan. These frameworks require the integration of climate resilience criteria, which further reinforces the systematic uptake of climate-proofing practices in transport infrastructure investments.

> *'There is no doubt that climate change is accelerating, leading to an increase in extreme weather events. A shift in approach and growing awareness of the importance of adaptation measures are essential to effectively address these challenges.'*
>
> **Krzysztof Rodziewicz, Head of the Transport Analysis Department, Centre for EU Transport Projects in Poland**

Strengthening climate-proofing in EU-funded transport infrastructure projects in Poland – Portal of the EU Mission on Adaptation to Climate Change

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Infrastructure

Hybrid engineered and nature-based solutions for flood risk reduction

Bilbao's industrial district redevelopment plan for climate resilience

Combining infrastructure, nature and finance to transform a flood-vulnerable district into a resilient community

Climate hazards:

Themes:

Zorrotzaurre district, Bilbao, Spain

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Key figures

60 %
reduction in flood risk

5 473
new homes and

202 129 m²
of commercial space created

Implementation timeline

Since 2012

Solutions

The project combines engineered flood protection with nature-based solutions in a hybrid approach to resilience. The approach integrates urban planning, flood risk management and economic redevelopment into a single strategy.

1. **Deusto Canal expansion.**
The peninsula has been transformed into an island, improving water flow and reducing flood risk by **60 %**.

2. **Ground elevation.**
Land has been raised by up to **1.5 metres** to protect new construction from rising water levels.

3. **Floodwalls and stormwater tanks.**
Floodwalls and storm-water tanks have been built in critical areas to store excess rainwater and prevent overflow.

4. **Nature-based solutions.**
New green spaces with parks, tree-lined pathways and pedestrian-friendly zones have been built in the area and act as natural flood buffers, increasing the permeable surfaces while boosting biodiversity and urban liveability.

Co-benefits

Economic
The public–private partnership structure distributes financial and operational risks, leveraging private -sector efficiency for infrastructure delivery. This model ensures long-term sustainability while aligning with urban development goals.

Social
Citizen engagement through public consultations leads to adjustments in the proposed interventions, increased social acceptance and cultural continuity. Historic buildings were conserved accordingly. The involvement of a local company in the financing process enabled the owners to receive financial incentives to refurbish the buildings. New green areas are deemed to positively impact citizens' health.

Environmental
The project boosts biodiversity through new green spaces and permeable surfaces while improving natural water management via the Deusto Canal and flood areas. Energy-efficient upgrades cut emissions.

Replicability – *Who can use this approach and how*

A scalable blueprint for climate-resilient urban redevelopment

How Bilbao's public–private partnership model and hybrid infrastructure finance can be adapted for coastal and riverside cities

Best suited for
This approach is particularly relevant for coastal and riverside cities exposed to increasing flood risks, especially where these challenges coincide with post-industrial regeneration or land-use transformation. It is well suited to authorities seeking to combine climate adaptation with economic development.

Stakeholders' role
The project is implemented through a public–private partnership bringing together the city of Bilbao, regional authorities, the port authority and private developers. This coordinated governance structure ensures alignment between planning, financing and implementation.

Built-in scalable tools
The model can be replicated through its governance structure, which links infrastructure investment with land development. It uses land value capture mechanisms to help finance adaptation measures and follows a phased approach that allows progressive upscaling. Its integrated planning framework, combining zoning, flood protection and green infrastructure, can be adapted to other contexts.

Funding pathways
The financing model relies on blended finance combining public investment and private capital. It is particularly suited to projects requiring high upfront investment and can be complemented by European funding instruments or other public financial support.

> *'Our young people have a place here to prepare, work and also live. An innovative model that is a driving force.'*
>
> **Juan Mari Aburto, Mayor of Bilbao, 2022**

Zorrotzaurre.com Climate-ADAPT Mission story

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Land use and food systems

Nature-based solutions | Smart agriculture | Stakeholder engagement

Boosting agriculture resilience across the Nordic-Baltic boreal region

Co-developed water, soil and crop management practices through inclusive stakeholder engagement

Climate hazards:

Main themes:

Nordic-Baltic region

Contact: Precilience project coordinator,
Natural Resources Institute, Finland

Key figures

43%
of nitrogen removal efficiency measured, with

90%
expected to be reached with full water recirculation in Denmark's Samsø site

44
sites selected or established across

5 countries

Implementation timeline

4 years
The Precilience project spans from 2024 to 2028

Solutions

Precilience is a Horizon Europe initiative under the EU Mission on Adaptation to Climate Change focused on testing and demonstrating transformative solutions for increasing climate resilience in the agriculture and forestry sectors across the Nordic-Baltic region. The project aims to enable participating regions to become frontrunners in building climate resilience by strengthening agricultural production in northern Europe through the practical implementation of proven, nature-based solutions tailored to local characteristics. Its primary objectives are to improve crop production resilience to changing climates, facilitate the adoption of robust solutions via stakeholder-centred demonstration tools and influence policies locally, regionallyand internationally to ensure a conducive economic and regulatory environment for climate-resilient agriculture. Solutions put forward through this project are as follows.

1. **Multipurpose crop diversification.**
   Actions on agricultural land – including crop diversification and rotation, cover crops, the introduction of methods to estimate the impacts of diversification and land use optimisation to improve soil structure – reduce nutrient losses and enhance overall resilience to drought and flooding.
2. **Climate- and landscape-based water solutions.**
   Measures such as irrigation and recirculation reservoirs, tile and controlled drainage, run-off control swales and berms, and sedimentation ponds are being tested to improve water availability and drought resilience.
3. **Soil management.**
   Soil management practices to alleviate climatic stress on crop production and the environment include adapted tillage practices comparing spring versus autumn ploughing, minimal tillage, and direct seeding and the application of soil improvers, such as biochar, structure lime and pulp mill sludge.
4. **Stakeholder engagement frameworks.**
   Co-creation processes involving stakeholder steering groups to ensure science-based knowledge is put into practice with inclusive collaboration.

Co-benefits

Economic

The agricultural solutions in Precilience offer several economic co-benefits, primarily through cost savings, income diversification and production stability. Water management strategies, such as drip irrigation with soil moisture sensors and the recirculation of drainage water for industrial use, reduce irrigation water consumption and reliance on groundwater abstraction. Soil management practices, including the application of biochar and structure lime, aim to sustain crop yields by improving root penetration and drought resilience. Additionally, diversification into specialty crops, renewable energy production (e.g. biogas) and biodiversity-focused cultivation methods provide farmers with alternative income streams while enhancing ecological and production resilience. External funding directed toward adaptation infrastructure, such as irrigation systems, water reservoirs and climate-adapted greenhouses, further supports these economic gains.

Social

The agricultural solutions in Precilience foster social co-benefits by strengthening community resilience through enhanced knowledge exchange and mutual support. Farmer-to-farmer exchanges, advisory services and regional workshops facilitate practical learning while creating networks that help mitigate the isolation and mental stress associated with climate uncertainty and economic pressure. The project prioritises inclusive participation through 'safer space' principles and active monitoring of gender balance in stakeholder engagements. Furthermore, these collaborative frameworks support intergenerational continuity by ensuring farms remain viable for younger generations and foster cross-sector collaboration among farmers, advisors, authorities and researchers to improve collective problem-solving capabilities.

Environmental

The agricultural solutions in Precilience deliver significant environmental co-benefits, particularly in reducing nutrient leaching, greenhouse gas emissions and soil degradation. Controlled drainage on peat soils significantly reduces nutrient losses to waterways, while raising the water table slows peat decomposition and diminishes greenhouse gas emissions. Sedimentation ponds, constructed wetlands and water reservoirs retain sediment and remove nitrogen, with Danish reservoirs achieving 43 % nitrogen removal efficiency, approaching 90 % under full recirculation. Soil management practices, including reduced tillage and the application of biochar and structure lime, improve soil organic carbon content, water holding capacity, aggregate stability and drought resilience. Nature-based solutions such as swales and berms capture run-off, prevent erosion and recharge groundwater, while cover crops and flower fields enhance biodiversity and ecosystem resilience. Together, these measures protect water quality, reduce erosion and strengthen the long-term health of agricultural landscapes.

Replicability – *Who can use this approach and how*

Replicating Precilience solutions across the Nordic-Baltic region

Stakeholder frameworks, monitoring protocols and nature-based designs ready for adaptation in boreal and temperate agricultural landscapes

Best suited for

Replication of these agricultural solutions is best suited for farmers and landowners across the Nordic-Baltic boreal region (Denmark, Estonia, Finland, Norway, Sweden) managing arable land dedicated to cereals, forage, oilseeds, dairy or specialty crops.

Stakeholders' role

Successful replication of these agricultural solutions requires collaboration among key stakeholders. Farmers and landowners are the main implementers, supported by advisory services and research institutes. Public authorities enable supportive regulations and permits, while the finance and insurance sector supports investment and risk management. Industry, value chain actors and non-governmental organisations help connect adaptation measures with markets and wider environmental and sectoral interests. Bringing these groups together is essential to overcome barriers such as complex policies, limited funding and knowledge gaps.

Built-in scalable tools

The built-in elements designed for replication include standardised stakeholder engagement frameworks, such as the stakeholder steering group structure, which provide a model for regional collaboration. Technical replicability is supported by specific monitoring protocols for water balance, nutrient recirculation and greenhouse gas emissions, alongside documented physical designs for controlled drainage systems and swales and berms that are intended to encourage replication in similar environmental conditions.

Funding pathways

The Precilience project was funded through the EU Mission on Adaptation to Climate Change with Horizon Europe grant agreement number 101157094.

Deliverable 1.2 · Agriculture — Precilience · Deliverable 2.1 · Deliverable 3.1 · Deliverable 5.2

This solution is part of Mission Solutions Catalogue

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Land use and food systems

Nature-based solutions | Forestry | Adaptive management

Precilience's demonstrators for boosting forest resilience across the Nordic-Baltic region

Co-created adaptation solutions delivering environmental, economic and social benefits for boreal forests

Climate hazards:

Main themes:

Nordic-Baltic regions

Contact: Precilience project coordinator, Natural Resources Institute, Finland

Key figures

343
stakeholders engaged

5
countries and **11** regions

Implementation timeline

4 years
The Precilience project spans from 2024 to 2028

Solutions

Precilience is a Horizon Europe project developing climate adaptation solutions for the forestry sector in the boreal regions of Denmark, Estonia, Finland, Norway and Sweden. Boreal forests face escalating pressures from rising temperatures, water stress, changing weather patterns and unsustainable forestry practices such as species monocultures and clear-cutting. These factors are already contributing to the spread of pests, pathogens and disease. The project's ultimate goal is to enable participating regions to become frontrunners in building climate resilience by testing and demonstrating transformative, nature-based solutions together with regional stakeholders, ensuring that outcomes are grounded in local realities and scalable across the Nordic-Baltic region. The solutions put forward through this project are as follows.

1. **Mixed-species regeneration.**
Trialling mixed coniferous and deciduous regeneration stands to enhance forest health and resilience against pests, diseases and drought compared to single-species monocultures.

2. **Adaptive forest management.**
Implementing closer-to-nature practices such as continuous cover forestry, selective cutting and shelterwood systems to link management methods with forest health and biodiversity outcomes.

3. **Precision forestry.**
Utilising forest harvester-based position mapping to detect decay-affected spruce trees and inform precision planting of the next tree generation, thereby minimising the transfer of pathogens.

4. **Assisted gene flow.**
Conducting clone trials across boreal countries to identify pine and spruce genotypes better suited to warmer, drier future climates, supporting the development of new deployment recommendations.

5. **Disturbance risk education and knowledge transfer.**
Organising field visits and webinars on sites illustrating severe disturbances to demonstrate how forest structure and management decisions influence damage risks, educating stakeholders on how to avoid regeneration decisions that increase future damage susceptibility.

6. **Landslide management.**
Norway is demonstrating the use of continuous cover forestry and cable yarding on slopes to maintain root reinforcement and reduce hydraulic loading, mitigating landslide risks associated with clear-felling.

7. **Stakeholder co-creation.**
Establishing national stakeholder steering groups, organising field demonstrations and hosting workshops to ensure that solutions are co-developed with forest owners and practitioners and integrated into practical forest management.

Co-benefits

Economic

The Precilience project aims at delivering significant economic co-benefits by supporting the preservation of the timber economy while unlocking new revenue streams. Regional stakeholder narratives identify emerging carbon and biodiversity markets, hunting leases, rental activities and markets for climate-related wood products as alternative income sources. By implementing adaptive management practices that reduce the frequency and severity of disturbances such as bark beetle outbreaks and storm aftermaths, the project helps lower management costs and damage expenses. Additionally, longer growing seasons present opportunities for increased forest productivity and yield, enhancing the long-term economic viability of boreal forests.

Social

The Precilience project aims at delivering significant social co-benefits by prioritising empowerment, inclusion and community well-being. Through its co-creation approach, stakeholders ranging from forest owners to policymakers actively shape adaptation strategies, fostering ownership and building trust between science, policy and practice. The project applies principles of broad inclusion, ensuring gender balance and accommodating diverse identities in engagement activities. Capacity building occurs through education events like field visits and webinars, equipping practitioners with knowledge to manage climate risks. Strengthened peer networks reduce the mental strain and isolation often linked to climate uncertainty, while fair compensation models for landowners acknowledge their contribution. Additionally, the initiative supports intergenerational sustainability by helping stakeholders secure forest viability for future generations.

Environmental

The Precilience project aims at generating substantial environmental co-benefits across biodiversity improvements, carbon sequestration and ecosystem services. Forestry demonstrations promote forest health and biodiversity through mixed species stands, deadwood retention and continuous cover forestry practices that support ecological stability and soil biodiversity. The project supports carbon sequestration as both a climate mitigation function and an emerging revenue stream for forest owners. Nature-based solutions, including wetland restoration, floodplain utilisation and buffer zones, enhance water retention, reduce nutrient leaching and restore pollinator habitats. Improved water management infrastructure and soil health practices contribute to reduced erosion and enhanced resilience of forest and agricultural landscapes to extreme weather events.

Replicability – *Who can use this approach and how*

Replicating across boreal regions

Standardised protocols, co-created design and flexible frameworks enable uptake in new regions

Best suited for

The solutions developed by Precilience are best suited for replication by forest owners and practitioners across boreal and hemiboreal regions where similar climatic conditions and forest types exist.

Stakeholders' role

Replication of Precilience's forestry solutions requires the active engagement of a broad range of stakeholders. Forest owners, both private and public, serve as primary implementers of adaptive practices on the ground. Forest practitioners and advisory services translate research into practical guidance through field visits and training, while universities and research institutes design experiments, monitor outcomes and develop evidence-based recommendations. Policymakers and public authorities are essential for removing regulatory barriers and aligning solutions with subsidy and policy frameworks. Industry and business representatives contribute market context and support commercialisation, while the finance and insurance sector enables emerging carbon and biodiversity markets and risk-sharing mechanisms. Advocacy organisations and forest associations facilitate outreach and peer learning among landowners, and local communities ensure broad acceptance and accessibility of the solutions demonstrated.

Built-in scalable tools

Precilience embeds replicability into its core design through a combination of standardised methodologies and flexible adaptation mechanisms. The project utilises finalised field protocols, common analytical templates for climate impact narratives and interoperable modelling platforms to ensure consistency and comparability across regions while allowing for necessary adjustments for local site conditions. Transferable stakeholder engagement structures, such as the stakeholder steering groups, provide frameworks for collaboration that can be established in new contexts. Crucially, the demonstrations are explicitly built for replication with tools and resources designed for use beyond the project's lifetime, ensuring that the co-created solutions remain scalable and accessible to forest owners and practitioners in other boreal regions.

Funding pathways

The Precilience project was funded through the EU Mission on Adaptation to Climate Change with Horizon Europe grant agreement number 101157094.

Forestry — Precilience · Precilience · Deliverable 4.1 · Deliverable 5.2 · Deliverable 2.1 · Deliverable 1.2 · CORDIS EU

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Land use and food systems

Climate-smart forestry | Drought-resistant species | Stakeholder-led adaptation

Climate-smart forestry in Slovakia and Bulgaria

Adapting management practices to safeguard forests under a changing climate

Climate hazards:

Main themes:

Regions in western Slovakia and south-western Bulgaria

Contact: Katarína Balíková, Milan Janák, Michal Némethy
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Key figures

1793 ha
of experimental climate-smart forestry measures in Slovakia and Bulgaria

2
demonstration regions

Implementation timeline

Slovakia
2021–ongoing

Bulgaria
2022–ongoing

Solutions

Climate-smart forestry that combines adaptation, mitigation and stakeholder cooperation to boost resilience, carbon storage and multifunctional benefits.

Slovakia

1. **Thinning and canopy gaps.**
   There has been a reduction in dense monocultures and an increase in age and species diversity to improve resilience.
2. **Soil preparation.**
   Disc and mulcher methods have been used to support pine regeneration.
3. **Water retention.**
   Drainage channels have been closed and rebuilt, and reservoirs have been restored o enhance water resilience and support firefighters activities.
4. **Species transition.**
   Spruce monocultures have been replaced with native species.

Bulgaria

5. **Drought-resistant afforestation.**
   drought-resilient species have been planted in 10-hectare experimental plots. Monitoring is ongoing, despite initial drawbacks.
6. **Thinning trials.**
   Different thinning approaches have been tested, including manual and harvester-assisted methods in pine plantations.
7. **Natural forest conversion.**
   The focus has been shifted from timber to climate-resilient, mixed-species forests.

Cross-cutting

8. **Monitoring systems.**
Tree vitality, biodiversity trends and regeneration performance across sites have been assessed.

9. **Awareness-raising.**
Stakeholder engagement has been supported through information boards, guided walks and participatory workshops.

Co-benefits

Economic

Climate-smart forestry generates key economic co-benefits by ensuring long-term timber productivity through resilient species and adaptive management. It reduces costs linked to tree mortality and repeated replanting while creating new revenue streams from sustainable wood processing, eco-tourism and recreation. By fostering local collaboration, the approach also supports rural livelihoods and strengthens the forest-based economy.

Social

Climate-smart forestry fosters broad social co-benefits by engaging local communities, foresters and authorities in collaborative decision-making. Through awareness-raising initiatives, such as guided walks, workshops and informational campaigns, it builds public understanding of climate adaptation while promoting recreational and educational opportunities. This inclusive approach strengthens community ownership of forests, ensuring long-term support for sustainable management practices.

Environmental

Climate-smart forestry delivers multiple environmental benefits, including better water retention to mitigate droughts and floods, improved air quality and increased carbon storage. Additionally, it boosts biodiversity, as seen in the recovery of bat activity following targeted thinning interventions.

Replicability – *Who can use this approach and how*

Scaling up climate-smart forestry: models, tools and finance pathways

From local trials to regional adoption

Best suited for

This project is ideal for forest managers, state enterprises and local authorities in drought-prone or climate-sensitive pest-affected regions, particularly those managing lowland or mountainous forests. It also suits initiatives seeking to integrate climate adaptation, biodiversity conservation and sustainable timber production into forestry practices.

Stakeholders' role

The project operates through a collaborative stakeholder model, uniting national forest enterprises with scientists, non-governmental organisations (NGOs) and local stakeholders. Foresters lead on-the-ground adaptation, while researchers provide monitoring and technical guidance, and communities engage through awareness-raising and consensus-building.

Built-in scalable tools

The project's scalable tools centre on demonstration sites and adaptive management frameworks, designed for replication across similar regions. Practical trials, such as thinning methods in Slovakia and drought-resistant afforestation plots in Bulgaria, serve as real-world models for foresters and foster collaboration with scientists and the broader public, while monitoring protocols ensure measurable success.

Funding pathways

The project is primarily funded through the EU LIFE programme, with additional support from national forest enterprises and NGO partnerships. Its focus on sustainable timber productivity and ecosystem services also creates opportunities for private-sector engagement. Reduced replanting costs and emerging revenue streams further strengthen the investment potential of climate-smart forestry for both public and private stakeholders.

> *'A key step in integrating climate-smart forest management into daily forestry practice is fostering strong cooperation among foresters, scientists, and the general public. This collaborative effort is essential to create meaningful pressure for change and to ensure that forest management strategies are both scientifically sound and socially supported.'*
>
> **Milan Janák, Conservation Director, World Wide Fund for Nature Slovakia**

Climate-smart forest management for central and eastern Europe · Clima4ceelife.eu · Mission story

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Land use and food systems

EU LIFE | Climate resilience

Boosting forest resilience to heat, drought and wildfires: the Soria ForestAdapt solution

An initiative funded by the EU programme for the environment and climate action (LIFE), building climate resilience in Mediterranean forests through adaptive management, innovation and partnerships

Climate hazards: Main themes:

Soria, Castile and Leon, Spain

Contact: info@soriaforestadapt.es

Key figures

66 kha
of forests burned in Castile and León in 2022

15 pilot tests
across **200 kha** of public and private land in the Soria province

Implementation timeline

2020–2025
duration of the project under EU LIFE19 CCA/ES/001181

Solutions

Climate-smart forestry is about managing forests so that they remain healthy, productive and resilient in a changing climate. The **LIFE Soria ForestAdapt** project demonstrates how forests can better withstand heat, drought and wildfires while also delivering benefits for biodiversity, local economies and soil health. By combining traditional practices with innovation, the project offers practical and scalable solutions for the future.

What's behind the approach?

1. **Adaptive forest management in six steps:** a practical, step-by-step guide to integrate climate adaptation into forest planning, tailored to local conditions and needs.
2. **Real-life pilot actions across 15 forest sites:**
   (a) **thinning trees** to reduce density, improve water availability and lower wildfire risk;
   (b) **assisted natural regeneration** and **drought-tolerant species** to strengthen forest health;
   (c) **silvo-pastoral systems** combining grazing and forestry to prevent fires and revive traditional land use;
   (d) **structural diversification** through mixed-age forests and canopy management to increase resilience.
5. **Smart digital tools for better decisions:**
   (a) **ForestAdapt Tool** maps future climate suitability for key tree species according to different climate scenarios;
   (b) **Fitoclim** monitors plant health and anticipates vegetation changes to guide forest management.
6. **Innovative financing – the 'zero solutions' model:** a portfolio approach that enables businesses to invest in climate action through partnerships with local stakeholders.

Co-benefits

Economic

The approach supports the revitalisation of rural economies by diversifying income streams linked to forests, such as sustainable timber production, agroforestry, grazing and ecosystem services. It helps create and maintain local jobs in forest management, restoration, monitoring and conservation activities. By reducing wildfire damage and ecosystem degradation, it also lowers long-term economic losses and public recovery costs while strengthening the economic viability of forest-dependent communities.

Social

The model strengthens cooperation between public authorities, private stakeholders, local communities, landowners and research institutions, creating a shared governance framework for forest management. It helps reconnect communities with traditional land-use practices, such as silvo-pastoral systems, which carry cultural and territorial identity. By improving landscape resilience and reducing disaster risks like wildfires, it also contributes to safer living conditions and stronger social cohesion in rural areas affected by depopulation.

Environmental

The intervention delivers multiple environmental gains by improving biodiversity and restoring ecological connectivity across fragmented landscapes. It enhances soil stability, reduces erosion and improves water retention, which are particularly important under drought conditions. Mixed-species and structurally diverse forests increase ecosystem resilience to climate stressors, including pests, heatwaves and fire. The approach also supports carbon sequestration, helping forests act as long-term carbon sinks while enabling the recovery of degraded or abandoned silvo-pastoral landscapes.

Replicability – *Who can use this approach and how*

Scaling up climate-resilient forest management

The Soria ForestAdapt model is highly replicable as it combines adaptable planning tools, private-sector engagement and inclusive governance. While it is designed to respond to Mediterranean climate risks, it can be adapted and applied in a wider range of regions facing similar environmental pressures.

Best suited for

This approach is particularly relevant for Mediterranean and southern European regions affected by prolonged droughts, extreme heat, wildfires and water scarcity. It is especially effective in areas with degraded or mono-species forests, along with territories facing rural depopulation and the abandonment of traditional land-use practices.

Stakeholders' role

Replication is based on a multistakeholder governance approach that brings together public authorities, private-sector stakeholders, local communities and research organisations. This collaborative framework ensures shared ownership, aligns interests across sectors and supports the co-design and implementation of locally adapted solutions.

Built-in scalable tools

The model includes a set of practical tools that facilitate replication and scaling. These include a six-step adaptive forest management guide, the ForestAdapt and Fitoclim digital decision-support platforms and the innovative 'zero solutions' financing model, which helps structure investment in climate-resilient forest actions.

Funding pathways

The approach is supported through EU-funded pilot programmes that enable testing and early implementation. These funds can be complemented by public–private partnerships, which help mobilise additional investment while engaging local stakeholders and strengthening long-term, forest-based livelihoods.

> *'As a reference province in forest management at a national level […], we want to continue working on improving our management and lead the way to manage our forests with the disturbing climate change that haunts us.'*
>
> **José Antonio Lucas Santolaya, Head of the Territorial Service for the Environment of the Regional Government of Castile and León**

Funded by EU LIFE · **SoriaForestAdapt.es** · **Mission Adaptation Portal**

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Water management

Sponging | Monitoring | Water retention

Restoring landscape sponging in the Lèze River Basin, France

Using a combination of nature-based sponge measures with monitoring and modelling data to restore the water retention abilities of the catchment landscape

Climate hazards:

Main themes:

Lèze River Basin, France

Contact: Gottfried Wilhelm Leibniz Universitaet Hannover, Germany (SPONGEWORKS project coordinator)

Key figures

More than
80
farmers involved

23
monitoring stations

Implementation timeline

4 years
The project spans from 2024 to 2028

Solutions

The SpongeWorks project aims to strengthen the EU's resilience to floods and droughts by demonstrating, testing and scaling-up nature-based 'sponge measures'. Such measures strengthen resilience to these climate hazards by improving water retention across interconnected soil, groundwater and surface water systems. Working with local stakeholders, the project develops practical, inclusive landscape-scale strategies, sharing best practices to transform water and land management for long-term climate resilience across the EU. One of the project demonstrations is within the Lèze River Basin, an area in which agricultural operations have shifted from extensive livestock systems to cultivated crops over the past decades. This change has drastically reduced the water retention capabilities of the landscape, and sponge measures and monitoring actions are being implemented to counteract these impacts.

1. **Sponge measure implementation.**
Sponge measures are being implemented on farms, public land and private property. On farms, agroecological measures such as green cover crops, temporary meadows and compost application are being implemented. Leaky dams and infiltration ponds (swales, ponds) are being built on public and private lands. Lastly, hedges and riparian vegetation, including trees and dry hedges, are being planted.

2. **Monitoring and modelling.**
The sponge measures were complemented with the establishment of monitoring stations capable of measuring both water quality and quantity. Fourteen monitoring stations were placed within wells located on private property. Two stations were placed along the Lèze River itself, namely within the Labarthe-sur-Lèze and Le Fossat areas. A further 12 monitoring stations are being installed at the downstream outlets of the 12 pilot sub-watersheds to assess the cumulative impacts of sponge measures across the catchment. The data collected has been used to complete baseline modelling of the catchment.



Co-benefits

Economic

The solutions implemented help improve the long-term productivity of the area by strengthening the resilience of the surrounding agricultural land. This is possible since the sponge measures implemented increase soil moisture retention, reducing the risks of droughts, floods, mudslides and soil erosion. Apart from this, a decrease in floods also means that there is less nitrate and pesticide pollution due to run-off. Hence, the integrity of the soil is protected using low-cost nature-based 'no regret' interventions, lowering the need for more costly, synthetic input and reducing damage recovery costs associated with hazards. The use of monitoring stations and modelling also means that landowners and other actors can remain informed on the quantity and quality of water in the area, leading to better management of this resource in a more informed, cost-effective way.

Social

This demonstration site ensures that measures being implemented are contextual and tailored to the needs of the area. This is done through the involvement of over 80 farmers in the development and implementation of measures, with the solutions directly protecting local farmer livelihoods. Other stakeholders are also engaged, including local authorities, water management organisations, regional advisory organisations, environmental consultancies and citizens through participatory worksite activities. This collaboration encourages knowledge sharing between different stakeholder groups, creating a sense of shared responsibility and environmental stewardship. Apart from this, it also contributes to building local capacity for climate adaptation. All in all, the resulting landscape is expected to become more resilient to climate hazards, helping to safeguard local communities.

Environmental

The implemented sponge solutions improve the landscape's ability to retain and slowly release water, helping to reduce flooding, mudslides and soil erosion while increasing water availability during dry periods. In this way, the habitats, both in terms of wildlife and vegetation, are protected from climatic extremes and disasters. Practices such as cover crops, temporary meadows, leaky dams, swales, hedges and riparian vegetation increase soil infiltration and groundwater recharge, restoring soil organic matter and stability, and reduce surface run-off from compacted agricultural land. This can reduce water pollution from fertiliser chemicals, creating a healthier ecosystem. The use of monitoring and modelling can also help landowners and other actors decide when conservation efforts should be implemented due to water volume or pollution levels. These measures overall contribute to restoring local habitats that support biodiversity. Together, they strengthen the ecological functioning of the Lèze catchment.

Replicability – *Who can use this approach and how*

Scaling up the restoration of sponge landscapes

Combining nature-based solutions and monitoring to restore the water retention abilities of the Lèze River Basin

Best suited for

This model is best suited for river catchments that support large areas of agricultural land, while facing increasing flood and drought risks. It is especially relevant to areas where changes in land use, particularly farming intensification or expansion, have reduced the sponging abilities of the landscape due to factors such as conversion of grasslands, intensive tillage and the removal of hedgerows. Areas where farmers and landowners are interested in contributing to the co-design and implementation of such measures are also relevant, as it increases the potential of such measures in private and agricultural land, rather than public areas only only public areas.

Stakeholders' role

The model is based on a multistakeholder and participatory approach. One of its main characteristics is its engagement with local farmers, who implement the sponge measures. The project partners include two chambers of agriculture, a river management organisation, a hydraulic engineering consultancy, a research organisation and an international association active in the water sector. This breadth facilitates communication and exchange between their different fields, which do not necessarily have a previous history of working together. Finally, the territorial coordination around the project brings together government institutions, local authorities, agricultural stakeholders and associations, fostering dialogue and the emergence of new projects.

Built-in scalable tools

This model incorporates several mechanisms to support its replication and upscaling. These includes catchment-scale monitoring networks, which can be adapted to different catchment locations. This can then support modelling, as carried out in this demonstration, using the data obtained from the monitoring stations. Additionally, lessons learned from the pilot locations at this site may inform landscape-level implementation, contributing to decision-making associated with action plans that can be replicated in catchments facing similar hazards and characteristics.

Funding pathways

The SpongeWorks project has received funding through the EU's Horizon Europe research and innovation programme as part of the EU Mission on Adaptation to Climate Change and from UK Research and Innovation/HM Government.

CaseStudy • Report

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Water management

Nature-based solution | Water management | River restoration

Nature-based solutions and knowledge sharing for aquatic system restoration in Nouvelle-Aquitaine

Using a combination of different nature-based solutions and stakeholder engagement

Climate hazards:

Main themes:

Nouvelle-Aquitaine, France

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Key figures

1
demonstration site and

1
follower site

7
locations for nature-based solutions

Implementation timeline

5 years
The project spans from 2023 to 2028

Budget

EUR 37 000

Solutions

The Natalie project aims to help European regions adapt to climate change by developing and promoting nature-based solutions (NBS) that strengthen environmental and community resilience. One of the six case studies in this project is based in France, focusing on the restoration of aquatic systems. It involves a demonstration and a follower region (respectively, Nouvelle-Aquitaine and Grand Est).

1. **Demonstration site.**
The demonstration site is in the Vienne River Basin. The demonstration measures are being implemented across seven sites. These sites were first monitored to establish their initial states, following methods designed through research and ad hoc consultations. Monitoring activities included water flows and temperature measures, species inventories, landscape evolution monitoring, among others. Two types of NBS will be implemented across these sites: the removal of dams from watercourses; the neutralisation of drains, which are ditches or pipes installed in wet areas to capture water and drain it, in wetlands.

2. **Follower site.**
The follower site is in the Grand Est area and uses technical knowledge shared by the demonstration site. Local actors are being supported in designing and implementing their own projects, as well as developing socioeconomic models that positively impact biodiversity. Thanks to external private funding, three NBS projects are being implemented and monitored: the restoration of headwater hydrological networks in forest ecosystems to increase water retention; the neutralisation of drainage systems; and the recovery of remarkable ecosystems such as tufa marshes.



Co-benefits

Economic
The measures in the demonstration site contribute to the restoration of rivers and wetlands. This helps to secure water resources by reducing unnecessary and excessive evaporation from the artificial ponds created, or by improving water storage in peatlands by removing drains. In doing so, water availability during dry periods can be improved. This supports economically important sectors such as agriculture, industry and potable water supply. Costs associated with water scarcity may also be avoided, such as increased irrigation. In the follower region, the project also supports the development of biodiversity-positive socioeconomic models and helps to mobilise private funding for NBS projects.

Social
The case study strengthens collaboration between different stakeholders, including public authorities, landowners, researchers and local communities, through co-design processes and knowledge sharing. Local stakeholders are involved in the monitoring and implementation of the different NBS. The follower region receives support to identify local climate challenges, develop adaptation projects and build capacity for NBS. These activities increase awareness and improve local resilience to climate change.

Environmental
The implemented NBS in the case study restore natural river processes by removing dams from the watercourses, or by removing drains from wetlands. This helps to reconnect aquatic habitats, restoring wetlands. These actions improve river flow, reduce evaporation, increase the water storage capacity in soils, restore sediment transport, enhance water quality, support fish migration, reduce flood peaks and increase biodiversity. By restoring ecosystem functions, the project also strengthens resilience to drought and other climate-related pressures while improving the long-term health of aquatic ecosystems.

Replicability – *Who can use this approach and how*

Scaling up the resilience of natural aquatic systems

Restoring natural aquatic systems in other regions

Best suited for

This model is best suited for regions with degraded rivers, wetlands, where climate change and previous human interference is increasing the risks of drought, water scarcity, biodiversity loss and declining water quality. It is particularly applicable in catchments with artificial water bodies and drainage systems that are impacting river flow, and hence where restoring the natural hydrological functions of the river can improve ecosystem resilience. The approach is also well suited to regions that wish to combine ecological restoration with stakeholder engagement and evidence-based monitoring.

Stakeholders' role

Successful implementation of this model requires collaboration between public authorities, water management organisations, researchers, landowners, environmental organisations and local communities. Researchers provide technical guidance and monitoring methodologies, while public authorities and water managers coordinate planning and implementation. Landowners and local stakeholders support the delivery of measures and contribute local knowledge. In follower regions, stakeholders work together to identify local adaptation priorities, develop projects and explore innovative financing mechanisms for NBS.

Built-in scalable tools

This case study incorporates different features that support replication and scaling. It is structured around the demonstrator and follower region. This enables replication by facilitating exchange between the two areas. In the demonstration site, standardised monitoring methods generate data and evidence on the effectiveness of the measures being implemented. This provides practical experience that can be transferred to other regions. Knowledge exchange between the demonstration and follower regions supports capacity building, and the co-design approach enables solutions to be adapted to different local contexts.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Natalie project, as part of the EU Mission on Adaptation to Climate Change.

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Water management

Landscape approach | Cross-border collaboration | Sponge landscapes

The Vecht River Basin's transboundary sponge strategy

A shared cross-border approach to multipurpose landscape management in response to climate change

Climate hazards:

Main themes:

Vecht River Basin, Netherlands, Germany

Contact: Gottfried Wilhelm Leibniz Universitaet, Hannover, Germany (SpongeWorks project coordinator)

Key figures

More than
tourism
9
sponge measures covering
1 217 ha

1 climate-resilient cycling route
has been completed

Implementation timeline

2024–2028
SpongeWorks project timeline

Solutions

The SpongeWorks demonstrator implemented a series of solutions across the Netherlands and Germany, aiming at transforming the whole transboundary Vecht River Basin into a sponge-like landscape, where water can be retained locally for longer periods across the whole basin, in soils, groundwater and rivers. The following solutions are put forward through this project.

1. **Rewetting and water retention.**
In Germany, grasslands, forests and meadow-bird areas are being rewetted. In agricultural areas in both Germany and the Netherlands, measures such as weirs and trench-bottom ramps are being implemented to retain water and improve water availability during dry periods.

2. **River and floodplain restoration.**
Nature-based measures are being used to restore and renature riverine areas. These include floodplain restoration in the Landkreis Grafschaft Bentheim and the renaturation of riverbanks along the Vecht in the Netherlands, helping to restore natural water retention and improve ecological conditions.

3. **A climate-resilient cycling route.**
Along a cycling route, nature-based solutions are being integrated into the surrounding infrastructure and landscape to retain and infiltrate rainwater locally. This helps slow run-off and increase water storage in soils and green areas while contributing to climate-resilient public space.

4. **Water monitoring.**
Monitoring stations and other monitoring activities are being used to assess the effects of the implemented measures. The collected data provides insights into water retention, groundwater dynamics, and resilience to floods and droughts, supporting learning about the effectiveness of different interventions.

5. **Cross-border stakeholder engagement.**
Four participatory workshops, including one focusing on geodesign, bring stakeholders from Germany and the Netherlands together to explore how water-retention measures can be combined and connected across the basin. The workshops support the development of a shared, landscape-scale approach to climate resilience and support the delivery of a cross-border sponge strategy for the Vecht Basin.



Co-benefits

Economic

The SpongeWorks project generates economic co-benefits by combining improved water management with cross-border planning and local development. Investment in water monitoring stations supports more efficient and better-informed management of water resources, helping authorities and stakeholders respond to drought and flood risks in ways that can reduce future damage and related costs. The workshops strengthen cooperation between partners and help align spatial planning decisions across the region, which can improve the effectiveness of public investment by harmonising competing interests and prioritising interventions. At the same time, cycling infrastructure contributes to the area's recreational and touristic appeal, supporting local businesses and broader regional attractiveness. Together, these elements are reinforced by the cross-border sponge strategy, which promotes coordinated, long-term resilience and creates wider economic value through reduced climate vulnerability and stronger territorial cooperation.

Social

The demonstrator in the Vecht River Basin strengthens cross-border cooperation around shared water challenges by actively involving local stakeholders through participatory activities such as workshops. These processes help raise public awareness of water management and climate adaptation while building a shared understanding of how the wider landscape can better retain and manage water. The approach contributes to enhancing possibilities for recreation and everyday well-being through improved cycling infrastructure and more attractive landscapes, encouraging outdoor activity with positive effects on health and quality of life. By combining collaborative water management, public participation and cross-border connections, SpongeWorks helps foster stronger, more informed and more resilient local communities.

Environmental

The SpongeWorks cross-border demonstrator delivers important environmental co-benefits by combining water retention with nature-based landscape management. By restoring the area's ability to retain water for longer, it helps reduce drought stress, supports healthier soils and ecosystems and can lessen pressure during periods of heavy rainfall. Its cross-border approach also strengthens ecological connectivity and promotes more resilient management of the shared landscape, while the associated cycling infrastructure encourages low-impact access to the area. In addition, the project's renaturation measures are expected to positively impact biodiversity by creating or reconnecting habitats, supporting a wider range of species and improving ecological resilience.

Replicability – *Who can use this approach and how*

A replicable model for cross-border river basins

Shared planning and cooperation for stronger cross-border resilience

Best suited for

The SpongeWorks demonstrator model is particularly well suited for replication in **cross-border river basins** that aim to achieve integrated water and landscape management through coordinated action. By bringing together relevant actors across administrative and national boundaries, it supports joint planning, shared decision-making and aligned measures that reflect the interconnected nature of river basin systems. This makes it especially valuable for river basin authorities, water managers and cross-border governance bodies seeking practical, cooperative approaches to addressing common water and landscape challenges.

Stakeholders' role

To replicate the SpongeWorks model in other cross-border river basins, a broad partnership of stakeholders should be involved. This includes regional and local authorities, water management bodies, environmental organisations, agricultural actors and national and cross-border governance structures. Scientific partners also play an important role by providing knowledge and evidence, while civil society helps ensure local engagement and acceptance. Together, these actors enable the coordinated action required for integrated water and landscape management across borders.

Built-in scalable tools

The SpongeWorks model is replicable in other cross-border river basins because it is based on transferable governance principles. Its core elements, such as integrated water and landscape management, cross-border coordination, shared planning and multistakeholder cooperation, can be adapted to different river basin contexts while keeping the same overall approach. By aligning actors across borders, sectors and levels of governance, the model provides a practical framework for jointly addressing flood resilience, water retention and landscape restoration in a coordinated way.

Funding pathways

The SpongeWorks project has received funding from the EU's Horizon Europe Mission on Adaptation to Climate Change programme and from UK Research and Innovation/HM Government. The progressive provision of evidence on the effectiveness of the solutions put forward through the project could also incentivise novel funding pathways, fostering public–private partnerships among the stakeholders involved.

SpongeWorks • SpongeWorks project in Vecht • Geodesign workshop in Vecht • Hardenberg project • CORDIS

This solution is part of Mission Solutions Catalogue

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Water management

Modelling | Regional water cycle | Stakeholder | Workshops

Modelling regional water cycles in Berlin-Brandenburg, Germany

Using a combination of innovative modelling systems and stakeholder engagement to better understand the regional water cycle and how to manage it

Climate hazards:

Main themes:

Berlin-Brandenburg, Germany

Contact: Fundacio Eurecat, Dr Nasrin Haacke and Dr Daniel Wicke (Kompetenzzentrum Wasser Berlin gGmbH) (impetus coordinator)

Key figures

2
modelling solutions and a visualisation tool

3
stakeholder workshops

Implementation timeline

5 years
The project spans from October 2021 to December 2025

Budget

EUR 400–600k
to reproduce the multi-model approach

EUR 100–200k
to adapt the visualisation tool

Solutions

The intelligent management of processes, ethics and technology for urban safety (IMPETUS) project aims to accelerate the EU's climate-neutrality and adaptation efforts by developing practical, scalable actions that strengthen resilience across communities, sectors and regions. It worked to empower stakeholders with the knowledge, data and innovation capacity to co-design, implement and sustain effective climate resilience solutions across seven EU biogeographical regions. The first demonstration tackles the continental biogeographical region, using the Berlin-Brandenburg Metropolitan Region as the target area. This area, though characterised by a large surface area of rivers and lakes, is facing increasing water stress due to prolonged drought periods, low natural river flows and changing groundwater recharge, with additional future pressures expected from changes in regional water management.

1. **Simplified models.**
A combination of simplified and detailed modelling approaches was developed, improved and applied to assess future water availability, water quality and the effects of climate adaptation measures in Berlin. The models support the implementation and further development of Berlin's Masterplan Wasser and address the interactions between surface water, groundwater, bank filtration and drinking water production.
   (a) **Berlin water model.**
   The Berlin water model is a simplified dynamic model of Berlin's surface water system. It considers wastewater treatment plant effluents, stormwater run-off, combined sewer overflows and waterworks abstractions to calculate flows, the shares of different water inputs and pollutant concentrations. Its flexible configuration allows different climate and water management scenarios to be assessed.
   (b) **Integrated mapping and modelling of regional water resources.**
   This solution combines detailed groundwater and surface-water modelling with simplified modelling approaches. Detailed models are used to analyse aspects such as bank-filtration dynamics, groundwater recharge, river flows and water levels, while simplified models enable rapid scenario assessment. Model results can be displayed through a map-based visualisation tool, helping communicate complex results and compare the potential effects of water management measures.

2. **Stakeholder outreach.**
The modelling activities were complemented by a series of stakeholder workshops. The workshops were designed to translate model results into practical and policy-relevant discussions, allowing stakeholders to explore climate and water management scenarios and their potential consequences. Key stakeholders included the Berlin Senate for the Environment and Berliner Wasserbetriebe, together with representatives from research, non-governmental organisations, and public authorities. During the workshops, model results and selected measures from Berlin's Masterplan Wasser were presented and discussed. Interactive scenario calculations and visualisations enabled participants to explore how changes in water availability, wastewater inputs and management measures could affect Berlin's water system.



Co-benefits

Economic

The solutions implemented in this demonstrator support more cost-effective and resilient water management by enabling more informed long-term planning of water management and associated investments. Using the integrated modelling systems of the region's groundwater, surface water and waste water, along with other factors, this approach can help identify which adaptation measures are the most effective. This may reduce overspending on unnecessary interventions. In this way, by testing different climate and demand scenarios, decision-makers can prioritise investments that support the necessary production of drinking water to support regional communities while avoiding excessive spending. Additionally, better understanding of pollution risks – and hence better management better management of risks – may reduce costs associated with pollution recovery.

Social

By improving water management in the Berlin-Brandenburg region, this demonstrator helps ensure constant access to sufficient drinking water. Additionally, the demonstrator placed significant emphasis on stakeholder engagement. Through innovative workshop approaches and other forms of engagement, different actors were involved in the co-design of solutions, ensuring that local concerns, such as water scarcity and competing water use, were properly integrated into planning. This participatory approach may have increased trust and acceptance of future adaptation measures, as the stakeholders could see that they were informed by reliable modelling data. Conflicts between different water users can also be resolved using such methods. By supporting informed decision-making, the demonstrator contributes to safeguarding essential water services for households, industry and communities under increasing climate stress.

Environmental

The use of modelling tools implemented in this demonstrator contributes to the improved protection of aquatic ecosystems by assessing how different factors like drought periods, wastewater discharges and stormwater run-off interact with the regional water cycle and how this can be managed sustainably. In particular, by understanding how these different factors impact water quality in the region, these models can support the design and implementation of measures to reduce pollution levels and protect local wildlife. Additionally, the information generated by the models can help decision-makers better understand the links between water extraction and groundwater availability, ensuring that the integrity of such ecosystems is protected through sustainable abstraction, maintaining groundwater balance. Overall, the approach promotes a more climate-resilient and environmentally sustainable regional water system.

Replicability – *Who can use this approach and how*

Scaling up the modelling of regional water cycles

Using modelling solutions and stakeholder engagement to better manage regional water cycles

Best suited for

This model is best suited for densely populated, water-stressed regions having reduced natural water flow due to rising temperatures and facing strong competition between different water users, such as drinking water, industry, agriculture and ecosystem needs. It is particularly relevant for regional systems that go beyond individual community use, relying on interconnected surface water and groundwater resources. This model can especially be used for regions with semi-closed water cycles, i.e. where treated wastewater re-enters freshwater bodies and contributes to potable supplies through groundwater extraction.

Stakeholders' role

The model uses a quintuple helix stakeholder approach during engagement, covering five interconnected groups of stakeholders, namely, government, industry, academia, civil society and the natural world representatives. In this way, input and perspectives from all involved actors are factored in when designing future solutions. The engaged stakeholders were chosen using a detailed stakeholder mapping process, taking many different aspects into account. In the specific case, the two most relevant actors involved were the Senate of Berlin and Berliner Wasserbetriebe, Berlin's public water utility and Germany's largest water utility company.

Built-in scalable tools

This model is built around scalable modelling tools. The Berlin water model itself is tailored to Berlin's specific water system, but its underlying modelling concept is transferable and can be configured for other catchments where suitable input data is available. The broader multi-model approach can also be adapted to other regions facing water scarcity, particularly where interactions between surface water, groundwater, treated wastewater and drinking water production need to be assessed. Transferability depends on the availability and quality of regional hydrological, water-quality and infrastructure data. The map-based visualisation approach can likewise be adapted to communicate model outputs to technical and non-technical stakeholders and support participatory decision-making.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Impetus project, as part of the EU Mission on Adaptation to Climate Change.

CaseStudy • Model1 • Model2 • D1.2

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Water management

Modelling | Open tenders | Water efficiency

Climate-resilient water management in the Main River Basin

Optimising water use in resource-intensive areas

Climate hazards: Main themes:

Main River Basin, Germany

Contact: Panepistimio Thessalias (Arsinoe project coordinator)

Key figures

12–15
stakeholder groups involved in the Living Lab

Maximum 10 km
between citizen water refill stations

Implementation timeline

2021–2025
Arsinoe project timeline

Solutions

The Arsinoe project developed innovative approaches to strengthen climate resilience across Europe. In Germany's Main River Basin, it combined stakeholder engagement, digital modelling and open innovation to improve water allocation and support more sustainable management of increasingly scarce water resources.

1. **Systems innovation approach.**
A systems innovation approach brought together local stakeholders through a Living Lab to identify climate challenges, map barriers and co-design adaptation solutions. Using systems thinking, the process helped develop a shared understanding of water risks across sectors and identify practical priorities for action.

2. **Open tender for innovations.**
The priorities identified through the Living Lab were translated into an open tender for innovations, inviting external organisations to propose practical climate adaptation solutions. The following two projects were selected for implementation.

(a) **IRRIBIGDATA.** A digital irrigation decision-support tool that combines climate, hydrological and agricultural data to optimise irrigation, reduce water use and improve drought resilience.
(b) **Public drinking water system.** Existing drinking fountains were upgraded and new refill stations installed to improve access to drinking water during heatwaves. Public awareness campaigns also promoted tap water use and sustainable water management.

3. **Modelling activities.** Hydrological modelling was used to assess future water availability under different climate scenarios. The results support long-term planning by providing information on groundwater, soil moisture, evapotranspiration and future water demand.



Co-benefits

Economic
More efficient irrigation reduces water use and long-term operating costs while improving resilience to drought. Better water allocation also helps protect agricultural productivity and reduce economic losses linked to increasing climate variability.

Social
The Living Lab strengthens collaboration between farmers, water managers and public authorities while improving access to climate information. This participatory approach increases trust in adaptation measures and supports fairer, more transparent water management.

Environmental
More efficient irrigation and sustainable water allocation reduce pressure on rivers and groundwater resources while helping ecosystems better cope with increasing water scarcity.



Replicability – *Who can use this approach and how*

Managing water scarcity through innovation and collaboration

How Living Labs, digital tools and innovation can improve river basin management

Best suited for
This approach is particularly suitable for river basins facing increasing competition for water between agriculture, ecosystems and other users. It is especially relevant where climate change is reducing water availability and evidence-based allocation is becoming increasingly important.

Stakeholders' role
Successful implementation requires collaboration between public authorities, river basin managers, farmers, researchers, utilities, non-governmental organisations and local communities. Open innovation mechanisms can also engage private companies and technology providers in developing practical solutions.

Built-in scalable tools
The Living Lab methodology, systems innovation approach and hydrological modelling can all be adapted to other river basins. Together, they provide a transferable framework for identifying local priorities, testing innovative solutions and supporting evidence-based water management.

Funding pathways
The pilot was developed through the Horizon Europe-funded Arsinoe project, as part of the EU Mission on Adaptation to Climate Change. The open tender approach also demonstrates how EU funding can stimulate innovation by supporting external solution providers and creating opportunities for future public and private investment.

Case study 3 • Deliverable 2.1

This solution is part of Mission Solutions Catalogue

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Water management

Industrial pollution | Alternative water sources | Water reuse

Using nature-based solutions for water reuse in industry in Oinofyta, Greece

Using a combination of three nature-based measures to treat three alternative water sources

Climate hazards:

Main themes:

Oinofyta, Greece

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

3
distinct processes

Possibility to meet
70 %
of the area's industrial water demand

Implementation timeline

5 years
The project spans from 2023 to 2028

Solutions

The Cardimed project aims to strengthen climate resilience across the Mediterranean by implementing solutions integrating digital infrastructure and nature-based solutions. One of the project demonstrations is in Oinofyta, Greece, an industrial hub with a concentration of chemical, metallurgy and food processing factories. This has resulted in severe contamination of the nearby river. This demonstration implements a nature-based system for the treatment and reuse of different water sources to meet the industry's operational needs.

1. **Demand-driven industrial water symbiosis system (DDIWSS).**
   The management system being implemented focuses on the recovery, treatment and reuse of rainwater, peri-urban run-off and industrial waste water. This system operates through three distinct processes. Each of these processes is tailored to a distinct water stream, and each of them uses a dedicated form of nature-based solution (NBS).
   - **Process 1.** The first NBS in the system is a 'hybrid xeriscape bioswale system'. This harvests peri-urban run-off and storm water. The harvested water is then reused to irrigate an urban garden of native plant species in the area.
   - **Process 2.** A biofiltration column, connected to an underground rainwater harvesting tank, was installed for the treatment of rainwater. The column contains a multilayered filtration medium, including sand, gravel and zeolite. The top of the column contains a vegetated layer, promoting the growth of a biofilm. This biofilm contributes to pollution removal using absorption.
   - **Process 3.** The final NBS is a subsurface flow constructed wetland. This wetland functions as a biofiltration system that treats waste water produced by local industry. The effluent can then be reused within industrial processes.



Co-benefits

Economic

The DDIWSS reduces the industry's dependence on fresh water by recovering and reusing rainwater, peri-urban run-off and treated industrial waste water that would otherwise not be used. By using these alternative, treated water sources for industrial activities like cooling and storage, the system can meet more than 70 % of the area's industrial water demand. By reducing reliance on external water sources, some procurement costs may be avoided while increasing resilience to water scarcity. The use of low-maintenance NBS supports resource efficiency, while avoiding costly upkeep interventions.

Social

Oinofyta is a very water-stressed region. The demonstrator contributes to healthier and more resilient local communities by reducing pressure on local water resources and improving water quality in an area affected by industrial pollution. Additionally, harvested storm water is reused to irrigate a native plant garden. This creates greener spaces, enhancing the local landscape and demonstrating sustainable water management practices. It is anticipated that these measures may encourage the wider adoption of NBS by industry and other local stakeholders.

Environmental

The DDIWSS improves local environmental quality by capturing and treating three different water streams for reuse. Interventions like bioswales, biofiltration columns and constructed wetlands remove pollutants such as heavy metals. They also help reduce stormwater run-off, which in turn may reduce the further spread of pollutants. Additionally, by reducing pressures on local water sources, freshwater abstraction may be reduced. Together, these NBS help protect surrounding water bodies, support biodiversity through native vegetation and wetland habitats and strengthen climate resilience by promoting sustainable and circular water use.

Replicability – *Who can use this approach and how*

Scaling up the resilience of water-stressed industrial areas

Treating alternative water sources in other regions

Best suited for

This model is best suited for industrial areas facing water scarcity, industrial pollution and high industrial water demand issues, in particular industrial parks and manufacturing zones in places seeking to reduce freshwater abstraction. It is particularly applicable to locations where multiple alternative water sources, in this case storm water, rainwater and industrial waste water, can be recovered, treated and reused through NBS.

Stakeholders' role

This model requires close collaboration between stakeholders such as industrial operators, local and regional authorities, water utilities, environmental agencies, research organisations and local communities. Industrial partners provide operational knowledge and host the treatment systems, while public authorities facilitate permitting, planning and regulatory compliance. Research organisations support monitoring and optimisation, and stakeholders are engaged throughout planning, implementation and evaluation to ensure the solutions respond to local environmental, technical and governance conditions. This multistakeholder approach is a core element of the Cardimed methodology.

Built-in scalable tools

Replication is supported by Cardimed's digital framework, which harmonises environmental data collection, monitoring and impact assessment across demonstration sites. The project also provides documents such as a catalogue of NBS, demonstrator action plans, stakeholder engagement methodologies, water–energy–food–ecosystem nexus modelling tools and replication roadmaps to help adapt solutions to different regional contexts. These tools enable evidence-based planning, facilitate transferability and support the scaling of successful interventions, through the Cardimed collaborative network, the EU Mission Adaptation Community of Practice and potentially broadly beyond those.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Cardimed project, as part of the EU Mission on Adaptation to Climate Change.

CaseStudy • D5.1

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Water management

Nature-based solutions | Sponge landscapes | Sustainable agriculture

Nature-based solutions and sustainable farming in the Pinios River Basin in Greece

A collaborative approach to water management, soil health and sustainable rural livelihoods

Climate hazards: **Main themes:**

Pinios River Basin, Greece

Contact: Gottfried Wilhelm Leibniz Universitaet, Hannover, Germany (SpongeWorks project coordinator)

Key figures

11 000 km²
river basin area

Consortium of
11 partners

Implementation timeline

2024–2028
SpongeWorks project timeline

Solutions

The SpongeWorks demonstration project in the Pinios River Basin in Thessaly, Greece, is an initiative focused on helping the basin become more resilient to increasing water-related pressures, especially floods, droughts and wider climate impacts. Its overall purpose is to support a healthier and more balanced relationship between water, land and ecosystems across the river basin. More broadly, the project aims to strengthen the area's ability to retain water in the landscape, improve the sustainable management of water and land resources and reduce vulnerability for communities, agriculture and nature. At its core, SpongeWorks seeks to promote a more integrated and long-term approach to river basin management, enhancing resilience, supporting environmental health and helping the region adapt to future climate challenges. The solutions put forward through this project are the following.

1. **Nature-based water retention measures.**
Several nature-based solutions (NBS) are being implemented across the Pinios River Basin to reduce run-off, increase infiltration and increase water retention. These include riparian forest restoration and a sponge demonstration park in the Trikala area, management of biomass in urban and peri-urban green spaces in the Agia area and terrace restoration with soil water harvesting and reuse in the Melivia area.

2. **Soil health and sustainable farming practices.**
Sustainable farming practices, such as mulching, cover crops and soil water management, are being tested and monitored in three different implementation areas (Karditsa, Agia and Melivia areas). In Karditsa, strip-tillage and cover crops are also being applied in cotton fields, with the aim of improving soil structure, water infiltration and retention while reducing soil disturbance. Low-tillage practices are combined with buffer zones/strips.

3. **Stakeholder engagement and participatory approaches.**
Local communities and regional stakeholders are engaged through participatory workshops to co-design sponge strategies for a more resilient Pinios River Basin. Stakeholders from agriculture, water management, public authorities, research and other relevant sectors contribute local knowledge, identify priorities and explore potential synergies and conflicts between different land and water uses. This approach supports the development of solutions that are better aligned with local needs, capacity and implementation conditions. Along with national stakeholders, they evaluate the regulatory and legislative framework in place to identify the needed changes to lift governance barriers in support of the transformation to sponge landscapes. This paves the way for the adoption and wider implementation of sponge solutions nationwide.



Co-benefits

Economic

The measures implemented in the framework of SpongeWorks aim to strengthen the economic resilience of agriculture by improving water and soil management and supporting more sustainable farming practices. In the longer term, improved water retention and more efficient resource use can contribute to reducing production risks and costs. In addition, these measures help strengthen resilience to floods, droughts and other climate impacts, which can reduce damage and disruption for farmers and the wider local economy. By improving the basin's ability to cope with water-related extremes, the project can also support more stable agricultural production and lower the economic risks linked to climate variability.

Social

The project generates important social co-benefits by bringing farmers, land managers, water authorities and other stakeholders into a shared planning process. Its participatory approach supports knowledge exchange, builds trust, improves communication and helps build a common understanding of water-related challenges such as drought, floods and land degradation. By involving stakeholders directly in the design and implementation of sponge measures, the project strengthens local ownership, facilitates knowledge exchange and supports more inclusive decision-making and cross-sector coordination. It may also contribute to reducing conflicts over water use and enhance long-term institutional capacity for resilient landscape management. Overall, the project's measures support strengthening primary agricultural production, through which the risk of abandonment of rural areas can be reduced.

Environmental

The SpongeWorks project combines NBS for sustainable water management and sustainable agriculture to improve the capacity of the landscape to retain water. Measures such as strip-tillage, mulching, buffer zones and other landscape-level interventions enhance natural water retention, improve soil health, increase infiltration, reduce surface run-off and erosion and contribute to greater resilience to flood and drought events. At the same time, it is anticipated that these measures will enhance habitat quality, strengthen biodiversity and support healthier and more resilient river basin ecosystems, contributing to more sustainable land and water use.

Replicability – *Who can use this approach and how*

Replicating integrated approaches for river basin resilience

Applying a participatory, cross-sector approach to identify, implement and assess sponge measures under different environmental, agricultural and institutional conditions

Best suited for

Agricultural river basins facing combined flood, drought and water management challenges, particularly where different sectors compete for water and land resources and where there is a need to coordinate NBS, sustainable agriculture and water management across the whole river basin.

Stakeholders' role

The development and implementation of SpongeWorks' pilots in the Pinios River Basin are based on a multistakeholder, participatory approach that involves farmers, local and regional authorities, water management bodies, researchers, environmental organisations and project partners.

Built-in scalable tools

The Pinios demonstrator combines participatory workshops, stakeholder engagement, monitoring and the implementation of sponge measures. These elements provide a framework for connecting local knowledge and scientific evidence with spatial planning and implementation decisions. The approach can be adapted to other river basins with similar climate, water management and agricultural challenges.

Funding pathways

The SpongeWorks project has received funding from the EU's Horizon Europe research and innovation programme under grant agreement number 101156116 and from UK Research and Innovation/HM Government. The longer-term uptake of sponge measures will require appropriate combinations of public funding, agricultural support schemes, environmental incentives and, where appropriate, private investment. The project is examining the conditions needed to support the long-term viability and wider uptake of the implemented measures. Farming measures are expected to be financially self-sustained following a period of time needed to yield tangible results for the farmers.

SpongeWorks • Mission projects catalogue • Land Reclamation Department • Article 1 • Article 2 • Article 3 • Article 4 • CORDIS

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Water management

Transboundary collaboration | Resource conflict | Digital innovation

Improving transboundary water management in North Macedonia, Albania and Greece

Facilitating transboundary collaboration to better allocate water resources as climate-change-driven water scarcity increases competition across economic sectors

Climate hazards:

Main themes:

Ohrid and Prespa lakes (North Macedonia, Albania, Greece)

Contact: Panepistimio Thessalias (Arsinoe project coordinator), suzana@iege.edu.mk; o.rousos@necca.gov.gr, nensi.lalaj@planifikimi.gov.al

Key figures

Collaboration among

3

countries

2

innovations selected from an open tender

Implementation timeline

2021–2025

Arsinoe project timeline

Budget

EUR 900 000

Solutions

The Arsinoe project developed innovative approaches to strengthen climate resilience through systems innovation. In the transboundary Ohrid–Prespa lake basin, shared by North Macedonia, Albania and Greece, the project addressed growing water scarcity by combining digital monitoring, integrated water management and cross-border cooperation. Together, these solutions help balance competing water demands while protecting one of Europe's most valuable freshwater ecosystems.

1. **Integrated water management model.** The integrated water management model combines hydrological, climate, economic and social data to support evidence-based decisions on water allocation. By modelling water availability alongside the needs of agriculture, industry, tourism, fisheries and households, it helps authorities balance competing demands while protecting ecosystems.

2. **Open tender for innovative solutions.** An open tender invited innovative companies to demonstrate mature digital solutions for water monitoring and management through grants from EUR 25 000 to EUR 50 000. The following two solutions were selected.
   (a) **Water4All.** A digital monitoring system that measures groundwater levels in real time, provides early warnings of water shortages and makes information available through web and mobile applications.
   (b) **Integrated water resilience system.** A digital platform that combines sensors, drones and data management tools to monitor water resources, analyse trends and support better decision-making.
3. **Systems innovation approach.** Stakeholders from the three countries worked together through national working groups and transboundary living labs to identify shared challenges, co-design adaptation pathways and evaluate innovative solutions. This collaborative governance approach helped build trust while supporting the coordinated management of shared water resources.



Co-benefits

Economic

The integrated management approach improves water security for sectors that depend on reliable water supplies, including agriculture, tourism, industry and public water services. Better forecasting and real-time monitoring also help authorities anticipate shortages, prioritise investments and reduce the long-term costs of water scarcity.

Social

The project strengthens cooperation among North Macedonia, Albania and Greece through participatory governance and the transparent sharing of water data. Public access to monitoring information and training materials improves trust, supports informed decision-making and helps communities better prepare for increasing water stress.

Environmental

Continuous monitoring and integrated planning help maintain healthy lake levels, reduce ecological stress and protect the unique biodiversity of the Ohrid and Prespa lakes. Together, these measures strengthen the long-term resilience of one of Europe's most important freshwater ecosystems.



Replicability – *Who can use this approach and how*

Scaling up transboundary water management

Managing shared water resources across borders

Best suited for

This model is particularly suitable for transboundary river basins and lake catchments experiencing increasing water scarcity and competing demands between sectors. It is especially relevant where neighbouring countries or regions need shared evidence to support coordinated water management.

Stakeholders' role

The approach brings together public authorities, water utilities, researchers, businesses and local communities through collaborative governance structures. Open innovation mechanisms, including competitive calls for solutions, also encourage private-sector participation and accelerate the deployment of new technologies.

Built-in scalable tools

The project combines transferable digital tools, integrated water modelling and collaborative governance methods that can be adapted to other river basins. With appropriate local data, these tools provide a practical framework for improving water allocation, monitoring climate impacts and supporting evidence-based adaptation.

Funding pathways

The demonstrator was developed through the Horizon Europe-funded Arsinoe project, as part of the EU Mission on Adaptation to Climate Change. The open tender approach also demonstrated how EU funding can leverage additional innovation by supporting external technology providers and creating opportunities for future public and private investment in climate resilience.

Arsinoe • Factsheet • Deliverable 3.6 • Deliverable 6.5 • CORDIS

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Water management

Floodproofing | Cooling | Multifunctionality

Várzea Urban Park: an innovative climate adaptation project in the heart of Setúbal, Portugal

Combining flood prevention and heat reduction with nature-based solutions

Climate hazards:

Main themes:

Setúbal, Portugal

Contact: Cristina Coelho
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Key figures

+ 1.6 °C–3.3 °C
annual average increase in temperatures projected by end of the century

5–17 % reduction in precipitation
expected by the end of the century

Implementation timeline

15 months

Solutions

The city of Setúbal has faced repeated flooding in its city centre over recent decades, driven by intense rainfall events that exceed the capacity of existing drainage systems. In response, the municipality developed the Várzea Urban Park as a multifunctional, nature-based solution combining flood management, climate adaptation and urban regeneration.

1. **Flood risk reduction.**
The park integrates large retention basins designed to control storm water during heavy rainfall events, significantly reducing flood risk in the city centre. With a capacity of approximately 240 000 cubic metres of water, the system helps prevent an overflow of drainage infrastructure and protects surrounding urban areas from flash flooding.

2. **Enhanced soil sponge effect and urban cooling.**
The project increases permeable green surfaces in the city centre, improving soil infiltration capacity and strengthening the 'sponge city' effect. This reduces surface run-off while also contributing to lower urban temperatures and improved microclimatic conditions, addressing both flood risk and the urban heat island effect.

3. **Tree planting and environmental education.**
A tree planting programme involving local schools was introduced as part of the project, combining hands-on learning with climate awareness activities. These initiatives have transformed the park into an outdoor environmental education space, strengthening community understanding of climate adaptation and encouraging long-term behavioural change.

4. **Ecologically driven spatial planning.**
The Várzea Urban Park operationalises Setúbal's master plan by embedding ecological principles and ecosystem services into urban spatial planning. This ensures that green infrastructure and natural systems are fully integrated into territorial development strategies rather than treated as isolated interventions.



Co-benefits

Economic

The Várzea Urban Park generates significant economic co-benefits by reducing climate-related damages in Setúbal. Flood retention basins help prevent costly impacts on infrastructure, businesses and residential areas during extreme rainfall events, lowering recovery and repair expenses. At the same time, the expansion of urban green space reduces heat stress, contributing to improved public health and lowering associated healthcare costs, particularly during heatwaves. Together, these effects strengthen the city's long-term economic resilience and reduce financial vulnerability to climate extremes.

Social

The project delivers strong social co-benefits by creating inclusive green space and strengthening community engagement. School-based tree planting and educational activities enhance environmental awareness among younger generations, while the park itself provides accessible recreational space in the city centre, improving well-being and quality of life. By involving residents in the design and stewardship of the area, the project fosters local ownership and environmental responsibility. In addition, improved flood protection enhances public safety and increases overall urban resilience.

Environmental

The Várzea Urban Park delivers key environmental benefits by embedding nature-based solutions into urban infrastructure. Retention basins reduce flood risk by managing storm water effectively, while expanded green areas increase soil permeability and improve water retention capacity. These measures also help mitigate urban heat and support biodiversity by creating new habitats in the city centre. By aligning with Setúbal's ecological spatial planning framework, the project strengthens ecosystem services and promotes a more sustainable and climate-resilient urban environment.

Replicability – Who can use this approach and how

A scalable model for nature-based urban adaptation

Turning flood-prone cities into climate-resilient green systems

Best suited for

This model is particularly well suited for coastal and riverine cities facing recurring flooding, intense rainfall events and rising urban heat, especially where conventional drainage systems are no longer sufficient. It is highly relevant for municipalities seeking to integrate nature-based solutions, such as retention basins, permeable landscapes and urban parks, into dense urban environments to simultaneously reduce flood risk, lower temperatures, enhance biodiversity and strengthen community well-being.

Stakeholders' role

The project was led by the Setúbal municipality, which coordinated design, implementation and EU funding mobilisation. Local schools and students played an active role through tree planting activities and environmental education programmes, strengthening community ownership and raising awareness of climate adaptation. This combination of municipal leadership and citizen engagement ensured both technical delivery and strong local anchoring.

Built-in scalable tools

The Várzea Urban Park offers a modular and transferable approach to climate adaptation. Its nature-based components, such as retention basins and expanded green infrastructure, can be replicated and adjusted to different urban contexts and risk profiles. The embedded educational and participatory framework further strengthens scalability by demonstrating how community engagement can be integrated into infrastructure projects. In addition, its alignment with Setúbal's municipal master plan illustrates how such solutions can be mainstreamed into long-term urban planning strategies.

Funding pathways

The project was financed through EU funding streams, with the Setúbal municipality securing over EUR 3 million to support implementation. These resources enabled the construction of retention basins, the development of green spaces and the roll-out of educational activities. The funding structure demonstrates a replicable pathway for leveraging EU support to deliver integrated, nature-based urban climate adaptation projects.

> *'The Várzea project protects Setúbal's city centre from annual flooding, recalling that the 2008 floods submerged cars in the city centre. With the Várzea intervention, the water accumulates in the retention basins and then progressively flows into the sea, preventing downtown flooding.'*
>
> **André Martins, Mayor of Setúbal**

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Water management

Nature-based solutions | Peatland restoration | Water resilience

Sponge landscape restoration: the SpongeBoost approach in Serra do Xistral

An evidence-based framework for peatland conservation and management

Climate hazards:

Main themes:

Serra do Xistral, Spain

Contact: SpongeBoost project coordinator, Helmholtz-Zentrum für Umweltforschung GmbH – UFZ, Germany

Key figures

22 963 ha
of Special Area of Conservation under Natura 2000, of which

4 600 ha
are peatlands

16 000 mm
of water input annually coming from orogenic condensation

Implementation timeline

4 years
The SpongeBoost project spans from January 2024 to December 2027

Solutions ([1])

SpongeBoost is a Horizon Europe-funded project under the EU Mission on Adaptation that upscales the natural sponge functions of freshwater ecosystems to deliver multi-benefit, nature-based solutions, combining a systematic literature review with testing at seven case study sites across four EU Member States. One such site is the Serra do Xistral peatlands in Galicia, Spain, the southernmost continental peatland landscape in the EU and a Natura 2000 site whose 22 963 ha Special Area of Conservation includes at least 4 600 ha of peatlands forming the headwaters of rivers draining to both the Cantabrian and Atlantic basins. Uniquely reliant on fog as a primary water source, with inputs of up to 16 000 mm annually via orographic condensation, this area was long understudied due to perceived limited economic value; it now faces threats from overgrazing and wind turbine installations.

([1]) Stachnik, A., Kuncar, C., Pontevedra Pombal, X. and García, H., 'Serra do Xistral peatlands', https://www.spongeboost.eu/storage/app/uploads/public/6a2/a5a/56c/6a2a5a56cd02d125795082.pdf. SpongeBoost, 'Case study areas', SpongeBoost website, https://www.spongeboost.eu/case-studies/serra-do-xistral-peatlands. Macháč, J., Brabec, J., Zaňková, L., Hekrle, M., Schmid, S. et al., 'Catalogue of innovative sponge solutions', Ares(2025)10386106, Zenodo, 31 March 2025, https://doi.org/10.5281/zenodo.15095308.

Within SpongeBoost, the objective is to understand how conservation status affects the hydrological functioning of these peatlands, as well as supporting the creation of a sustainable management plan in close collaboration with local stakeholders to retain and restore the sponge function of this landscape for strengthening water and climate resilience. The solutions put forward through this project are as follows.

1. **Evidence-based sustainable management planning.**
   At Serra do Xistral, the central solution developed within SpongeBoost is the creation of a sustainable management plan in close collaboration with local stakeholders for retaining and restoring the sponge function of the landscape. This plan is informed by two key supporting activities.

   (a) **Comprehensive monitoring programme.** Installed since September 2024 with continuous recording since late February 2025, this programme uses rain gauges, soil moisture and temperature sensors at four depths. It is complemented by water flow estimation across peatlands with different conservation states.

   (b) **Multisource data integration.** This combines field measurements with drone LiDAR (light detection and ranging) and Sentinel-2 satellite imagery to support multiscale hydrological analysis and modelling. The observed hydroclimatic events are analysed under different antecedent moisture conditions – spanning from dry to normal and wet – to examine how sponge functioning is expressed across different conservation trajectories, building on previous restoration work conducted under the scope of the LIFE in common land project.

Co-benefits ([2])

Economic

Based on broader SpongeBoost findings, several economic co-benefits could plausibly apply to Serra do Xistral. As headwaters for multiple regional rivers, the peatlands have a role in sustaining base flows and buffering hydrological extremes; this could reduce water management costs, potentially offering greater cost-effectiveness compared to traditional engineering approaches. Additionally, it could attract tourism and ecosystem service revenue thanks to the site's recognition as the only European global flagship landscape by Wetlands International.

Social

The SpongeBoost interventions at Serra do Xistral offer potential social co-benefits thanks to their collaborative management nature and downstream community protection. The sustainable management plan being developed within SpongeBoost is created in close collaboration with local stakeholders, building on the community-driven approach of the previous LIFE in common land project, which worked directly with common land communities. More broadly, the peatlands have an important role in sustaining base flows and contributing to downstream water quality, benefiting communities reliant on the downstream rivers such as the Landro, Ouro, Masma, Miño and Eume.

Environmental

At Serra do Xistral, the environmental co-benefits are closely tied to the peatlands' hydrological and ecological functions. The peat soils store water and release it slowly, buffering hydrological extremes, sustaining base flows and contributing to downstream water quality for regional rivers across both the Cantabrian and Atlantic basins. The site hosts 20 habitats of community interest, including blanket bogs, temperate Atlantic wet heaths, active raised bogs, transition mires and quaking bogs, supporting distinctive biodiversity across at least 4 600 ha of peatland environments. In addition, the high organic matter accumulation in these peat soils represents significant carbon storage potential.

([2]) Brotherton, P., McCamphill, C., Albert, C., Darmstadt, C., Penning, E. et al., 'Achieving better implementation of EU policies by restoring the sponge function', June 2026, https://doi.org/10.5281/zenodo.21722016. Penning, E., Wittmann, C., Alexiou, I., Barreau, S., Bérczi-Siket, A. et al., 'Advancing the water resilience strategy through sponge landscapes and nature-based solutions for a climate resilient Europe', 1 March 2026, https://doi.org/10.5281/zenodo.18853448.

Replicability – *Who can use this approach and how*

Replicating SpongeBoost's approach

Evidence-based sustainable management for peatland landscapes

Best suited for

The evidence-based sustainable management plan for peatland landscape restoration and maintenance, informed by systematic monitoring and multisource data integration developed at Serra do Xistral, is highly replicable to any peatland landscape project focused on restoration and maintenance of the landscape sponge function, with adjustments based on context-specific conditions.

Stakeholders' role

Successfully replicating the Serra do Xistral model requires engaging a multilevel stakeholder coalition mirroring the collaboration structure established at the site. Essential partners include local communities which would participate in the restoration project, and local administration bodies that would provide co-financing. Academic institutions are critical for delivering the scientific monitoring and data analysis that underpins the management plan. Private landowners and regional decision-makers must also be integrated to address land-use pressures like overgrazing and ensure long-term policy alignment, reflecting the project's emphasis on creating sustainable management plans through close collaboration with local stakeholders.

Built-in scalable tools

The Serra do Xistral approach incorporates several replicable built-in elements that form a sequential, adaptable methodology for peatland restoration. The process begins with a systematic inventory and classification of the peatland area, followed by the deployment of tiered monitoring infrastructure across sites with differing conservation states. Field measurements are then integrated with remote sensing technologies to support multiscale hydrological analysis and model development. A distinctive feature is the comparative analysis of well-preserved and degraded peatlands within the same site, examining how sponge functioning responds under different conservation trajectories and antecedent moisture conditions. All the evidence generated through these activities, once fed into the project's assessment framework, informs the development of a sustainable management plan. With adjustments for other peatland contexts and the deployment of similar monitoring infrastructure in other sites for field measurements, similar management plans can be developed in close collaboration with local stakeholders.

Funding pathways ([3])

The SpongeBoost project is funded through Horizon EU under grant agreement number 101112906.

This solution is part of Mission Solutions Catalogue

([3]) European Commission, 'Upscaling the natural sponge functions of freshwater ecosystems to deliver multi-benefit green deal solutions', European Commission website, 4 August 2026, https://doi.org/10.3030/101112906.

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Water management

Competing water demands | Sensors | Data accessibility

Managing competing water demands in the water-stressed region of Valais, Switzerland

Using digital tools to better manage water resources efficiently and engage the public

Climate hazards:

Main themes:

Valais, Switzerland

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Key figures

1
fully implemented platform connecting stakeholders with environment and solutions

5–25×
more irrigation is expected for agriculture to face droughts

Implementation timeline

5 years
The MountResilience project spans from 2023 to 2028

Solutions

MountResilience is a Horizon Europe project, funded through the EU Mission on Adaptation to Climate Change, aiming at helping mountain communities build resilience to the impacts of climate change. The project works across several alpine and mountainous regions to develop, test and scale practical adaptation and nature-based solutions tailored to local needs. It also aims to encourage behavioural change among citizens so they can better respond to climate challenges specific to mountain environments. Solutions put forward in the Swiss Valais region through this project aim to bring together and reconnect citizens, farmers, municipalities, water managers, energy producers, tourism operators and other local actors with the actual state of water resources, changing environmental conditions and existing adaptation solutions. The aim is to support informed decision-making and more coherent action in response to changing water availability. The demonstrator, called Mountis, includes the following parts.

1. **Sensor network.**
   A network of sensors has been deployed to collect real-time data in the watershed, including in remote areas and under severe environmental conditions. Data on water reserves, water flows, water quality and soil moisture is compared to historical levels to build the core indicators expressing the current situation, both for human activities and for ecosystem preservation.
2. **Digital platform.**
   A freely accessible digital platform was developed as a way of presenting related water and environmental data as clear and engaging indicators. These indicators were designed to be easily understood. Design research methods, including local observation, co-creative phases and cognitive science protocols allowed interactions and representations to be created which are engaging, simple and impactful for all stakeholders, including citizens. The platform is accessible as a multiplatform web app and links environmental situations to existing solutions with examples of effective implementation. Notifications can also be used in the app to alert users of unusual or critical situations. Observations by local stakeholders increase engagement of local communities.
3. **Implementation methodology.**
   An evolution in the decision-making process through the use of real-time data and the solutions catalogue. This methodology is the result of experimentation and workshops performed in different locations.

Co-benefits

Economic

The case study in Valais supports more efficient and transparent water allocation across competing sectors such as agriculture, hydropower, tourism and potable water supply. Real-time, evidence-based indicators foster prioritisation for essential uses during water-scarce periods, including economic activities like tourism, farming or energy production, while preserving drinking water availability for citizens. It also supports the development of transformative projects. Informed and evidence-based decisions help reduce water-related conflicts, lower delays, limit projects rejections and strengthen long-term resilience, leading to faster and more efficient investment.

Social

This case study emphasises the importance of inclusive research by ensuring that the more technical and scientific parts of the solutions are transformed into understandable, engaging indicators. This strengthens collaboration between different actors, such as water managers, researchers, businesses and citizens, by facilitating the shared access to clear water information. The digital platform encourages public engagement by integrating citizen observations, promoting climate awareness and supporting more inclusive decision-making. By improving local understanding of local water conditions, the approach helps to foster behavioural change, helping build trust and cooperation among stakeholders facing shared climate challenges.

Environmental

The implementation of sensors for the continuous monitoring of water quality and quantity, as well as soil moisture, improves the understanding of local watershed dynamics, supporting more sustainable water management. This in turn helps to protect freshwater habitats from excessive water extraction, helping to reach a balance between supply and demand without threatening the integrity of these areas. The project also promotes the use of nature-based solutions through a dedicated catalogue within the platform, encouraging measures that improve the resilience of mountain landscapes while protecting the ecosystems that support them.

Replicability – *Who can use this approach and how*

Replicating the Valais approach

How other mountainous regions can adopt sensor networks and digital platforms to harvest and disseminate important information on water management

Best suited for

This model is best suited for mountain regions where climate change is increasing pressure on water resources through glacier retreat, changing precipitation patterns, drought and competing water uses. It is particularly applicable in regions where robust data on these competing water uses is not yet available or need to be integrated into relevant resources for all stakeholders. This also applies to regions that do not have easily understandable water data and other types of environmental data. The solution could help regions where citizens and water stakeholders feel disconnected from the current situation and knowledge, to bolster participation and acceptance.

Stakeholders' role

The replication of this model depends on a quadruple-helix approach that brings together four main stakeholder groups, namely public authorities, research institutions, businesses and communities. In Valais, stakeholders co-create indicators, contribute local knowledge, participate in workshops and local councils and use shared scientific data to support collaborative decision-making. This participatory model is intended to strengthen ownership, build trust and ensure that adaptation measures respond to local priorities. The acquired knowledge, available platform and implementation methodology make Mountis easy to replicate, facilitating the involvement of stakeholders in the decision-making process with the use of real-time indicators and possible solutions.

Built-in scalable tools

The Valais demonstrator has been designed with replication in mind through the development of reusable digital and governance tools. These include guidance to implement a suitable sensor network, access to the open digital platform that translates environmental data into accessible indicators, citizen observation functions and a catalogue of nature-based solutions. Across MountResilience, these tools are complemented by implementation roadmaps and guidance for replicator regions to facilitate transfer and scaling.

Funding pathways

The MountResilience project is funded through Horizon Europe under grant agreement number 101112876. The Swiss partners have received funding from the Swiss State Secretariat for Education, Research and Innovation.

MountResilience.eu • CaseStudy • D2.1 • D1.3 • CORDIS

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Water management

Technology readiness level | Citizen experiment | Stormwater management

Stormwater management through innovation and community engagement in Lappeenranta, Finland

Empowering communities by enhancing climate literacy and driving stormwater innovation

Climate hazards:

Main themes:

Lappeenranta, Finland

Contact: Sanna Varis – sanna.varis@lappeenranta.fi
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Key figures

2 013
survey participants
Solutions up to
TRL 9

Implementation timeline

2021–2025

Budget

EUR 5 400/year
for each monitoring point
Free source code
for the citizen application

Solutions

Lappeenranta served as a demonstrator site for the TransformAr project. Supported by the EU Mission on Adaptation to Climate Change, TransformAr aims to develop and deploy transformational adaptation solutions for regions and communities across Europe facing water-related climate risks. In this demonstrator, the project combines technological solutions for stormwater management and run-off treatment with innovative citizen engagement tools.

1. **Stormwater monitoring.**
A real-time monitoring system for the city's stormwater network was developed at technology readiness level (TRL) 8. This system monitors flow rates and water quality, with the aim of preventing pollution and managing run-off. The tool's user interface is visual and browser-based, enabling easy access from a smartphone or laptop.

2. **Biofiltration area for urban run-off.**
An integrated biofiltration area was implemented in the city centre at TRL 7. This nature-based solution is part of emerging urban adaptation standards in Lappeenranta. It enables stormwater filtration and supports infiltration into groundwater systems, while reducing pressure on an under-capacitated stormwater sewer network and lowering the risk of overflow events.

3. **Discrete choice experiment.**
A discrete choice experiment was conducted at TRL 5 with 2 013 respondents from Finland and Norway. The survey assessed willingness to invest in grey and green stormwater infrastructure at the household level. Results show a clear preference for low-cost, low-maintenance and high-impact measures, highlighting strong potential for mobilising private investment and informing more targeted policy design.

4. **Crowdsourcing citizen application.**
A citizen-facing application was developed and deployed at TRL 9 to raise awareness about climate change impacts and adaptation. The application integrates citizen-reported data with municipal inputs, including flood and stormwater quality sensor readings, to provide a real-time, comprehensive view of flooding conditions. It also enables two-way communication between citizens and the municipality, improving public guidance during flood events.



Co-benefits

Economic

The innovations implemented through the TransformAr project reduce long-term disaster recovery costs by prioritising proactive climate adaptation. This is particularly relevant for the real-time stormwater monitoring system and the biofiltration area, which enhance urban water management and reduce flood risk. The discrete choice experiment supports the mobilisation of private investment in water management infrastructure by revealing stakeholder preferences and willingness to invest. In addition, the crowdsourcing application can reduce operational costs by streamlining emergency response in Lappeenranta, improving recovery efficiency and limiting business disruption and downtime.

Social

This demonstration project places citizens at the centre of adaptation planning and emergency response. The citizen application enables two-way communication between residents and the municipality, strengthening trust in local authorities and empowering communities to act during flood events. The discrete choice experiment also demonstrates the value of citizen input in shaping adaptation priorities, with results reflecting a clear willingness among residents to contribute. More broadly, the infrastructure-based solutions help reduce flood risk, contributing to improved safety, health and well-being. Through active citizen involvement, the project strengthens social cohesion and ensures that adaptation measures respond to local needs.

Environmental

The solutions implemented in Lappeenranta have a direct positive impact on water quality and ecosystem health. The biofiltration area improves water quality by filtering pollutants from storm water, while also reducing the volume entering the sewer system and thereby lowering the risk of overflow. The real-time stormwater monitoring system further enhances environmental protection by enabling timely interventions when overflow or excessive run-off occurs, reducing pressure on aquatic habitats.

Replicability – *Who can use this approach and how*

A scalable model for strengthening local adaptation planning

How this validation approach can be adapted to different regions

Best suited for

This approach is particularly suited for small to medium-sized cities facing increasing flood risks linked to ageing drainage infrastructure and extreme rainfall events. It is especially relevant for municipalities with limited public budgets but with strong community engagement and an openness to digital and participatory solutions.

Stakeholders' role

The project was developed through collaboration between the municipality of Lappeenranta and Lappeenranta-Lahti University of Technology, combining local governance, scientific expertise and citizen participation. Residents played an active role through engagement activities and crowdsourcing initiatives, helping validate adaptation measures and improve local preparedness.

Built-in scalable tools

The model is highly scalable thanks to the use of mature, high-TRL innovations and digital tools. The crowdsourcing application can easily be adapted and replicated in other cities and for different climate hazards, while the participatory survey methodology can be reused with tailored themes and local priorities. This flexibility allows municipalities to test, validate and refine adaptation measures in diverse contexts.

Funding pathways

The model was developed through the TransformAr project, funded under the EU's Horizon 2020 research and innovation programme (grant agreement number 101036683). The project demonstrates how EU research and innovation funding can support the testing and validation of scalable climate adaptation solutions at the local level. Its combination of digital tools, citizen engagement and applied research also creates opportunities for replication through regional development funds, national adaptation programmes and future Horizon Europe initiatives.

Mission story • **Project** • **CORDIS**

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Water management

Traditional knowledge | Water circularity | Decentralised interventions

Innovative water management in the Aegean Islands, Greece

Demonstrating circular wastewater management techniques to reduce water scarcity and increase climate resilience

Climate hazards:

Main themes:

Aegean Islands, Greece

Contact: Project coordinator, National Technical University of Athens (NTUA) smalamis@central.ntua.gr

Key figures

Nature-based solutions implemented in
3 demo sites

120 stone
check dams built

Implementation timeline
2023–2028

Solutions

Through the Cardimed (climate adaption and resilience demonstrated in the Mediterranean region) project funded under the EU Mission on Adaptation to Climate Change, the Aegean Islands in Greece are implementing innovative approaches to water management, combining modern and traditional techniques.

1. **Circular wastewater treatment.**
In Lesvos, domestic waste water is treated using a small-scale, nature-based system in the Antissa area. The system uses vertical subsurface flow and constructed wetlands to clean waste water, which is then reused to irrigate nearby agroforestry fields supporting mixed-species cultivation. At the same time, nutrients are recovered and returned to the soil, creating a circular system where both water and nutrients are reused efficiently.

2. **Traditional stone check dams.**
In Sifnos, traditional water management techniques have been revived through the construction of 120 locally sourced drystone check dams across two seasonal streams in the Kamares catchment. These structures reduce run-off during intense rainfall events. The system is complemented by sensors monitoring water levels and soil moisture, along with an online weather station tracking hydrological and climatic conditions.

3. **Rainwater harvesting.**
In Mykonos, the project combines water collection and irrigation systems at two sites. Rainwater and storm water are collected, treated and stored in detention tanks and reservoirs. The water is then reused for agriculture through optimised, sensor-based irrigation systems. At one site, the system also supports aquifer recharge during wet periods, ensuring water availability during droughts.



Co-benefits

Environmental
The nature-based water solutions deliver significant environmental benefits by addressing both water scarcity and extreme weather impacts. In Lesvos, circular wastewater systems reduce reliance on synthetic fertilisers, improve soil fertility and support biodiversity, while treatment wetlands provide habitats for native species. In Sifnos, reduced run-off limits soil erosion and protects ecosystems. In Mykonos, rainwater harvesting reduces pressure on overexploited aquifers, helping preserve freshwater ecosystems.

Social
The interventions strengthen community resilience and cultural continuity by combining citizen engagement with traditional knowledge. Reviving historic water management practices fosters intergenerational knowledge exchange and community pride. Outreach activities, such as walking tours, open days and focus groups, enhance stakeholder engagement and participation. These bottom-up approaches also encourage residents and farmers to move towards greater water self-sufficiency, reinforcing social cohesion.

Economic
These water management solutions generate cost savings and economic opportunities. By reducing reliance on energy-intensive treatment systems and imported water, operational costs are significantly lowered. Rainwater harvesting supports agricultural productivity, particularly for high-value crops, while wastewater reuse reduces fertiliser costs. Over time, these measures help reduce climate-related losses and strengthen the economic resilience of the islands.



Replicability – *Who can use this approach and how*

Replicating nature-based water management: models, tools and finance pathways

From the Aegean Islands to other regions

Best suited for
This model is particularly well suited for small island, and other remote arid or semi-arid areas facing acute water scarcity, recurrent droughts and flash floods. These conditions often lead to degraded freshwater sources and seasonal water stress. It is especially relevant in contexts where traditional water management approaches exist but where centralised infrastructure is costly, difficult to maintain or impractical due to geographic constraints.

Stakeholders' role
The approach relies on a collaborative governance structure. EU-funded projects work closely with municipalities and regions to provide strategic direction and project coordination, while citizens, local experts and community groups actively contribute to on-the-ground implementation. This ensures strong local ownership and adaptation to site-specific conditions.

Built-in scalable tools

Scalability is enabled by the modular nature of the interventions. Solutions can start as pilot sites and be progressively expanded over time. The combination of traditional water management practices with modern monitoring technologies improves both affordability and effectiveness. In addition, adaptive management supported by real-time monitoring systems allows continuous learning and improvement during replication.

Funding pathways

Implementation typically combines EU funding with national and municipal resources. EU climate adaptation programmes can help initiate projects, while local budgets and project-based financing ensure continuity, maintenance and upscaling over time.

> *'On our islands, water is life – and resilience is a duty for us decision-makers. By reviving traditional wisdom and pairing it with modern approaches and especially nature-based systems, scientists have proven that the Aegean can secure water, protect communities, and power local livelihoods even as droughts extend and extremes intensify. These solutions work because they are designed for our geography and governed with our people.'*
>
> **Ioannis Kalatzis, Director, Development Planning Directorate for the North Aegean Region**

Mission story • **Cardimed** • **Cardimed CORDIS**

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Water management

Stakeholder engagement | Wetland construction | Water quality

Constructed wetlands for wastewater treatment and climate resilience in Zemgale, Latvia

Combining stakeholder engagement and nature-based solutions to improve water quality, reduce eutrophication, enhance biodiversity and strengthen resilience to climate change

Climate hazards:

Main themes:

Zemgale, Latvia

Contact: Office International de l'Eau (Natalie project coordinator)

Key figures

2
newly constructed wetlands

Monitoring of
4
operational ones

Implementation timeline

2023–2028
Natalie project timeline

Solutions

The Natalie (accelerating and mainstreaming transformative nature-based solutions to enhance resilience to climate change for diverse bio-geographical European regions) project, as part of the EU Mission on Adaptation to Climate Change, aims to help European regions adapt to climate change by developing and promoting nature-based solutions (NBS) that strengthen environmental and community resilience. As the third demonstrator site in the project, constructed wetlands are being implemented and monitored in Zemgale, Latvia to improve wastewater treatment, reduce nutrient loads entering rivers and lakes, mitigate eutrophication and enhance biodiversity. These NBS also contribute to climate change adaptation by improving water retention and increasing ecosystem resilience during periods of drought and heavy rainfall.

1. **Pilot site identification**
Potential locations for wetland construction were identified. This process was informed by results and experience from already existing constructed wetlands. Site selection was based on various high-level criteria: the locations must be suitable for treating both diffuse pollution from agricultural fields and point-source pollution from livestock facilities and domestic wastewater treatment plants. Water samples were collected for analysis. The environmental and technical conditions of the sites were also assessed.

2. **Stakeholder engagement**
Preliminary meetings with local stakeholders were organised. During these meetings, the project was introduced and input from the various stakeholder groups was collected. Project results were disseminated at public events and in meetings with the Ministry of Agriculture and the Ministry of Climate and Energy. This engagement aims to increase the acceptance of constructed wetlands as a relevant wastewater treatment solution among both the public and stakeholders involved in water management and decision-making processes. In doing so, financial support for the broader implementation of these interventions will also be facilitated.

3. **Wetland construction and monitoring**
Two new wetlands are being constructed on the selected pilot sites. The effectiveness of these interventions, along with that of four additional already-operational constructed wetlands, will be monitored using modelling tools. A feasibility study for the upscaling of similar NBS in the region will be conducted.

Co-benefits

Economic

The economic co-benefits of this case study in Zemgale include reduced costs for both water treatment and nutrient management, using constructed wetlands as a natural filtration system. Wetlands can therefore lower expenses associated with aquatic pollution control originating from run-off and thereby decrease the need for expensive engineered infrastructure. Additionally, by retaining and slowly releasing excess water during heavy rainfall, they also reduce the risk of flooding. This indirectly reduces costs associated with flood damage, including expenditure on emergency response, infrastructural repairs and agricultural losses. Additional economic benefits may include improved agricultural productivity through better water management, as reduced run-off limits the loss of fertile topsoil.

Social

The social co-benefits of this case study mainly concern increased community awareness of sustainable water and land management practices through NBS. The targeted and detailed stakeholder engagement processes help build local capacity, encourage knowledge sharing and foster a sense of ownership of the solutions being implemented. This increases acceptance of the project, contributing to its long-term success. By reducing the risk of flooding and improving water quality, the wetlands also contribute to community well-being, protect local livelihoods, and support the provision of healthier and more resilient natural environments for current and future generations.

Environmental

The improved treatment of agricultural run-off and waste water through wetlands provides multiple targeted environmental benefits. These are achieved primarily through the removal of excess nutrients and pollutants from run-off before it reaches rivers and lakes. This helps reduce eutrophication, which is a process where excessive nutrient inputs trigger algal blooms that deplete oxygen levels in water, harm aquatic life and reduce biodiversity. The constructed wetlands also slow and retain surface run-off, preventing soil erosion that may contribute to the degradation of local ecosystems. In addition, wetlands create valuable habitats for local wildlife, enhancing biodiversity and ecological connectivity. Water retention is also enhanced, improving the resilience of local ecosystems to dry periods, while also enhancing carbon sequestration.

Replicability – *Who can use this approach and how*

Scaling wetland construction in other European regions

A transferable model combining NBS and stakeholder engagement

Best suited for

This model is best suited for rural and agricultural catchments facing flood- and drought-exacerbated risks of nutrient pollution and water quality degradation. The constructed wetland approach is especially relevant for regions with intensive farming activities, where nature-based interventions can improve water retention, reduce nutrient run-off and enhance overall ecosystem resilience.

Stakeholders' role

In this model, the Zemgale planning region took the governance lead, alongside the Latvia University of Life Sciences and Technologies, which provided technical input, and the Baltic Environmental Forum Latvia, which facilitated stakeholder involvement. Stakeholders, such as municipal decision-makers, citizens and farmers, were engaged to enhance knowledge sharing and increase acceptance of the project.

Built-in scalable tools

The key built-in scaling tool of this case study is the replication and twinning approach intrinsic to the Natalie project. This approach links demonstrator sites with follower regions to assess replication potential and enable knowledge transfer. In this case study, the identified follower site is a Lithuanian region vulnerable to similar climate hazards. More broadly, focused stakeholder engagement increases acceptance of interventions, thereby facilitating their scaling.

Funding pathways

The approach was developed through the Horizon Europe-funded Natalie project, as part of the EU Mission on Adaptation to Climate Change.

Mission story • **Natalie** • **CORDIS**

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Water management

Inclusive governance | Adaptive infrastructure | Nature-based solutions

Strengthening water systems and coastal defences in Friesland, the Netherlands

Nature-based solutions to restore rivers and marshes

Climate hazards:

Main themes:

Fryslân, Netherlands

Contact: Xandrie Borgmans, Provincie Friesland – x.borgmans@fryslan.frl

Key figures

8
historical courses redeveloped

3
petgaten developed

Implementation timeline

2023–2027

Solutions

The province of Friesland in the Netherlands is adapting its water systems and coastal areas to future climate risks through the restoration of river courses and the reinforcement of dykes under the Nbracer (nature-based solutions for Atlantic regional climate resilience) project and the Horizon 2020 Hydrousa project. Both initiatives aim to strengthen water resilience, biodiversity and quality of life, while reducing the risks of flooding, drought and salinisation through nature-based solutions.

1. **Stream restoration.**
Through a collaborative approach involving stakeholders across different governance levels, the stream between Nijeholtpade and De Blesse in the Linde Valley is being restored. This includes the redevelopment of eight historical courses, the construction of sloping riverbanks and the creation of three *petgaten*, which are wetland ponds filled by rainwater or groundwater that provide habitats for native species.

2. **Wetland restoration.**
Through the 1Dyk (one dyke) project, dykes along the Frisian Wadden coast have been restored through the development of salt marshes, grazing, fish passages and ecological corridors. This project was discontinued in December 2025 because partners failed to agree on agricultural land use and nature compensation.

3. **Stakeholder engagement.**
Strong stakeholder engagement is a central element of the approach, helping bridge the gap between long-term policy objectives and the local implementation of nature-based solutions. Workshops, community meetings, educational walks and dissemination activities support dialogue among stakeholders and encourage public participation.

Co-benefits

Economic

Initiatives such as Beekdalherstel De Linde and Fryslân Bûtendyks support long-term economic resilience and sustainability. Reduced flood risks and improved water quality benefit agricultural productivity and help lower climate-related economic losses linked to droughts and flooding. Restored natural landscapes and recreational opportunities also support sustainable tourism and local economic activity. In addition, reducing the need for artificial water inputs contributes to lower water management costs over time.

Social

The initiatives contribute directly to the well-being and quality of life of local communities. By involving residents and stakeholders throughout the implementation process, the projects foster community ownership, trust and support. Recreational opportunities provided by initiatives such as Beekdalherstel De Linde, including walking routes and kayak jetties, together with enhanced natural landscapes, further strengthen the social value of the interventions. Educational activities, awareness campaigns and public dialogue also promote environmental stewardship and greater understanding of climate adaptation challenges.

Environmental

By restoring rivers and wetlands, the initiatives in Friesland enhance biodiversity and strengthen ecosystem services such as water filtration, carbon sequestration and nutrient cycling. For example, the restoration of salt marshes with Fryslân Bûtendyks provides habitats for protected plant and animal species, whileriver re-meandering, as implemented through Beekdalherstel De Linde, helps restore natural water flows and reduce erosion. Improved water quality and reduced flood risks contribute to healthier and more resilient ecosystems.

Replicability – *Who can use this approach and how*

Replicating nature-based water management: models, tools and finance pathways

From knowledge exchange in EU projects to local action

Best suited for

This approach is particularly relevant for regions facing climate challenges such as flooding, drought, salinisation, heavy rainfall and sea-level rise that are interested in exploring nature-based solutions (NBS) but are not yet implementing large-scale measures. It is especially valuable for regions seeking to learn from existing experiences, assess local applicability and build the knowledge, partnerships and governance structures needed for future climate adaptation actions.

Stakeholders' role

A key element of the Friesland approach is the active involvement of stakeholders from different sectors and governance levels. Regional and local authorities, water managers, researchers, businesses, non-governmental organisations and local communities contribute knowledge, expertise and practical experience. Regional workshops and immersive visits created opportunities for stakeholders to exchange experiences, discuss local challenges and explore how successful NBS can be adapted to regional conditions. This collaborative approach helps build ownership, trust and long-term support for future implementation.

Built-in scalable tools

The Friesland approach combines lessons from Nbracer demonstration regions with experiences from existing NBS within the province, including initiatives such as Beekdalherstel De Linde and Fryslân Bûtendyks.The use of peer-to-peer learning, stakeholder engagement, site visits and knowledge-exchange activities provides a flexible methodology that can be applied in many different regional contexts.

Funding pathways

The activities undertaken in Friesland have been supported through the Nbracer project under the EU Mission on Adaptation to Climate Change. This support enables knowledge exchange, stakeholder engagement, capacity building and replication planning. The insights generated through this process can help regions identify future investment needs and opportunities within regional, national and European funding programmes for climate adaptation and NBS.

Nbracer CORDIS • Nbracer • Provincie Fryslân – Nbracer •
Beekdal Linde | Provincie Fryslân •
Landschapsbiografie Noard-Fryslân Bûtendyks | It Fryske Gea

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Water management

Flood resilience | Early warning systems | Municipal emergency planning

Local flood risk management in the Navarra region

Multilevel flood resilience: early warnings, digital tools and community action

Climate hazards:

Main themes:

Navarra region, Spain

Contact: Luis Sanz Azcárate, Arantxa Ursua Andrés
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Key figures

50
municipalities with high flood risk in the region

17
municipalities drafting a municipal plan.

104
rain gauges and

75
streamflow stations for flood risk tracking, supporting early warning systems.

Implementation timeline

2017–2030
LIFE-IP NAdapta-CC and Navarra's Climate Change Roadmap (2030)

Budget

EUR 15 000
(+EUR 5 000/year for maintenance) for the digital management tool

Solutions

As a climate change adaptation measure, when Navarra's regional strategy was drafted in 2017, 17 municipalities collaborated to develop municipal action plans against flood risk. The severe floods of 2021 demonstrated the usefulness of these plans. As a result, the number of plans increased from 5 in 2017 to 50 in 2026. These plans strengthen preparedness and response capacity, integrate up-to-date information, including real-time rainfall data, forecasts and streamflow data, and define clear emergency measures. The plans rely mainly on the following tools.

1. **Early warning systems.**
The project uses a real-time monitoring network comprising 104 rain gauges and 75 streamflow stations to track flood risk. Automated alerts are triggered when predefined rainfall or streamflow thresholds are exceeded, categorising risk into emergency levels according to severity.

2. **Digital tools for emergency management.**
A dedicated web and mobile application was developed to support real-time management. The tool centralises critical information, enables emergency levels to be activated and shows operational status through colours: green for completed actions, orange for actions in progress and red for pending actions. The platform centralises information on emergency levels and the specific measures to be carried out.the specific measures to be carried out, facilitating institutional coordination, preparedness and communication with the population.

3. **Community engagement and training.**
Community preparedness is reinforced through targeted information campaigns, workshops with residents and local stakeholders, and annual training sessions for municipal managers and operational teams.

4. **Cartographic annexes.**
Each plan includes cartography showing streamflow and precipitation monitoring stations, the official flood hazard and risk maps, and areas where preventive measures can avoid or reduce damage.

Co-benefits

Economic
The adoption of early warning systems and a preventive approach strengthens evidence-based decision-making and supports long-term planning. By enabling earlier action and better targeting of resources, these measures help reduce the costs associated with post-disaster recovery, emergency response and infrastructure repair, while significantly reducing damages. In the medium to long term, they also contribute to improving the efficiency of public spending by shifting investment towards prevention rather than crisis management.

Social
The project's collaborative approach to disaster risk management has a positive impact on community cohesion and solidarity. By involving municipalities, local responders and citizens, it strengthens trust and coordination across governance levels. Improved access to information and alert systems enhances individual and collective security, while awareness-raising activities and training increase overall preparedness. This contributes to building a stronger culture of risk awareness and shared responsibility among citizens.

Environmental
The plan creates an enabling framework for implementing preventive and self-protection measures that may also include nature-based solutions, such as restoring natural floodplains, wetlands and other landscape features that enhance water retention. These approaches not only help reduce flood risks but also offer multiple co-benefits, including biodiversity enhancement, improved water quality and increased ecosystem resilience. By integrating natural elements into risk management strategies, the project supports more sustainable and climate-resilient territorial planning.

Replicability – *Who can use this approach and how*

A scalable model for flood-prone regions

Navarra's approach offers a transferable blueprint for strengthening flood risk management and disaster preparedness across similar territories

Best suited for

Communities and territories exposed to flooding, especially where climate change is increasing the frequency or intensity of extreme rainfall.

Stakeholders' role

Multilevel coordination between local authorities, technical teams, emergency services, sectoral agencies and citizens to ensure rapid information flow and shared responsibility.

Built-in scalable tools

Monitoring networks, digital alert and real-time management tools, intermunicipal collaboration and citizen engagement to strengthen preparedness.

Funding pathways

Development is supported by EU funding and sustained in the long term through municipal and regional budgets for system maintenance, updating and operation. Initial cost estimate: for implementation, drafting a plan may cost between EUR 5 000 and EUR 20 000, depending on the size of the municipality and its actual flood risk. A digital management tool could cost around EUR 15 000. In addition, it would be advisable to have an annual maintenance budget, which could be around EUR 5 000 per year, although this may be lower in smaller municipalities.

> *'Drafting municipal emergency plans incorporating robust early warning systems in towns with significant flood risk facilitates local-level integration, which is closest to the population, in flood emergency management. This allows each local council to coordinate with Navarra Civil Protection and to be better prepared for potentially increasing risks due to climate change.'*
>
> **Luis Sanz Azcárate, Technical Director, Gestión Ambiental de Navarra**

LifeNAdapta • Hoja de Ruta Navarra • Mission story • Plan especial emergencias ante el riesgo de inundaciones de la Comunidad Foral De Navarra

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Water management

Technological innovation | Predictive water management | Data simplification

Using technology to understand flood risk information in the western Netherlands

Leveraging 3D digital twins, hydrodynamic models and gamification to translate flood risk information into practical insights

Climate hazards:

Main themes:

Western Netherlands

Contact: Jasper van Lieshout
Nelen & Schuurmans
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Key figures

1
integrated Decision Support System combining multiple tools
Spatial resolution of
up to 0.5 × 0.5 m
for high-precision flood modelling

Implementation timeline

2021–2025

Budget

EUR 10 000+
for basic 2D flood models
Up to EUR 150 000
for very detailed solutions

Solutions

Through the EU Mission on Adaptation to Climate Change project 'Impetus', a Decision Support System has been developed to improve flood risk management by combining several advanced technological tools into a single, integrated platform.

1. **Hydrodynamic software models.** At its core, the system uses hydrodynamic models based on Rana Water Intelligence software. These models provide accurate modelling of flood propagation under various climate conditions while simulating how water moves through landscapes under different rainfall and climate scenarios, including extreme events. They can capture flood propagation with very high spatial resolution (up to 0.5 × 0.5 metres), allowing detailed analysis of how water spreads across urban and rural areas and impacts critical infrastructure.

2. **3D digital twin environment.**
The model outputs are embedded in a 3D digital twin of the physical environment, built from real-world geographic, hydrological and infrastructural data. This enables users to visualise flooding scenarios dynamically in three dimensions, improving the spatial understanding of risk. Decision-makers can explore different layers, such as terrain, buildings, drainage systems and water flows, and test how the system behaves under varying climate conditions.

3. **Gamification.**
To make the system more accessible and intuitive, gamification features have been introduced. These allow users to interact with scenarios in a more engaging way, helping translate complex hydrological data into clear, visual and actionable insights. This supports dialogue between technical experts, planners and local authorities, and helps assess the potential effectiveness of adaptation measures before they are implemented in the real world.



Co-benefits

Economic
The economic value of the Decision Support System lies in its ability to reduce long-term flood damage while optimising adaptation investments. By providing high-resolution, scenario-based flood risk assessments, the system helps authorities and decision-makers prioritise cost-effective interventions before disasters occur. This proactive approach significantly reduces post-flood recovery and reconstruction costs, while improving the efficiency of public spending on climate resilience.

Social
The decision support system strengthens social resilience by translating complex flood risk data into accessible and actionable insights for communities. Through interactive 3D visualisations and gamified scenarios, it makes abstract climate risks more tangible, helping residents and stakeholders better understand local vulnerabilities and the effectiveness of proposed adaptation measures. This transparency builds trust in decision-making processes and encourages community engagement in flood preparedness. The system also helps bridge the gap between experts and non-experts, supporting more inclusive dialogue and a shared understanding of risk.

Environmental
The Decision Support System in the Netherlands supports environmental sustainability by enabling data-driven and ecologically sensitive flood management. By improving the understanding of flood dynamics, it helps optimise interventions, including nature-based solutions that enhance water retention, reduce erosion and strengthen ecosystem resilience. It also improves the forecasting of flood impacts, enabling more proactive and preventive decision-making. This allows authorities to anticipate environmental consequences earlier and implement protective measures in advance, reducing ecological damage and supporting more sustainable water management outcomes.

Replicability – *Who can use this approach and how*

Decision support system replicability: the western Netherlands and beyond

How technological tools enable better flood-risk planning and understanding

Best suited for

The decision support system is best suited for low-lying coastal, delta and riverine regions exposed to significant flood risks driven by sea-level rise, extreme rainfall, storm surges or river overflow. It is particularly relevant in territories where uncertainty about future climate impacts makes long-term spatial and infrastructure planning more complex, and where improved anticipation of flood dynamics is needed to support proactive adaptation strategies.

Stakeholders' role

This approach relies on a multidisciplinary model. Technology developers and data experts design and maintain the system, while government agencies provide policy direction, funding and use it for planning and decision-making. Water authorities contribute hydrological expertise, and local communities act as end users, ensuring relevance and usability. Research institutions support validation and continuous improvement.

Built-in scalable model

The system is highly scalable thanks to its open-source foundation and use of interoperable geospatial standards (Open Geospatial Consortium). This allows regions to adapt the tool and integrate local data without rebuilding it from scratch.
Its user-friendly design and strong visualisation tools also reduce technical barriers, enabling non-expert users to engage with complex flood scenarios and supporting easier replication across regions.

Funding pathways

The Impetus project was funded under the EU Mission on Adaptation to Climate Change, demonstrating how EU-level support can enable the development of advanced digital tools for climate risk management. This type of funding also supports experimentation, cross-border knowledge sharing and the scaling up of innovative solutions, making replication in other regions more feasible through future EU programmes, national co-financing or blended funding approaches.

> *'Innovative technologies like 3D Digital Twins can bridge the gap between complex data and clear insights, allowing everyone, regardless of expertise, to make well-informed decisions.'*
>
> **Joep Grispen, Director of Technology, Nelen & Schurmaans**

Mission story • **Rana Water Intelligence Software** • **Impetus** • **Impetus CORDIS**

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Finance and local economic systems

Climate risk insurance | Agricultural resilience | Participatory co-design

Creating climate risk insurance solutions for agriculture across Europe

Developing a demand-driven parametric insurance solution for climate-impacted farmers

Climate hazards:

Main themes:

Spain, Italy and Finland

Contact: Ilmatieteen Laitos (PIISA project coordinator)

Key figures

2
digital tools for agricultural insurance

600+ survey responses
from farmers

Implementation timeline

2023–2026
PIISA project timeline

Solutions

The PIISA (piloting innovation insurance solutions for adaptation) project, funded under the EU Mission on Adaptation to Climate Change, aims to develop innovative insurance and risk-sharing solutions that encourage households, businesses and public authorities to adopt climate adaptation measures and strengthen resilience to climate-related hazards. The third pilot study of the project supports improved understanding of climate risks in agriculture by developing an index-based insurance tool that meets the needs of farmers most impacted by climate hazards across Europe, while also remaining viable for insurance providers.

1. **Co-designing parametric insurance (CoDepi) tool.**
The CoDepi participatory tool was developed as an application (app) to help insurers create index-based insurance products that are commercially viable and useful for farmers. It was created for olive farmers in southern Spain to ensure that insurance products are in alignment with their needs and specific vulnerabilities. It aligns historical payouts with actual experiences of farmers on the ground, enabling researchers, insurers and the farmers themselves to define insurance trigger thresholds using climate data. CoDepi allows different configurations of its base index parameters, such as contract periods and climate thresholds, to be tested and their impact on historical payouts to be assessed.

2. **Seasonal forecasting climate service (Shiny).**
This tool provides farmers with access to forecasts of specific climate variables, expressed as probabilities of events. The forecasts use bias-adjusted metrics to maximise accuracy.



Co-benefits

Economic
The aim of this PIISA case study is to provide farmers with improved financial resilience in the face of worsening climate hazards. This is done through facilitating their understanding and quantification of the relevant climate risks, enabling more targeted and potentially more affordable insurance structures. For insurers, the CoDepi tool supports better-designed indices, which may increase uptake from end users due to increased trust in the system. Public authorities may also benefit, albeit indirectly, through a reduced need to provide emergency relief funds and payments.

Social
The tools were developed using highly inclusive co-design processes which prioritised those that are most impacted, i.e. the farmers themselves, through activities such as workshops and surveys. This process fostered increased collaboration and trust between the farmers and other stakeholders, such as insurers, researchers and agricultural organisations. This active involvement of end users maximises the relevance and usability of the solutions, while also increasing public awareness of climate risks in the context of regional agriculture. By doing so, the capacity of rural communities to engage with climate adaptation tools is increased, protecting their livelihoods.

Environmental
By providing more accurate information on seasonal climate changes and risks through the Shiny app, the solutions support more proactive and adaptive farm management under increasing climate stresses. Early awareness of hazards such as drought conditions can encourage more timely and efficient water use, which can, in the long term, protect local ecological systems.

Replicability – *Who can use this approach and how*

Scaling up climate insurance tools for farmers across Europe

Providing valuable information on climate insurance and forecasting for the agricultural sector

Best suited for

This model is best suited for regions with an agricultural sector that is highly vulnerable to climate impacts, such as drought and heat stress. It is particularly relevant for farmers, agricultural cooperatives, insurers and public authorities within these regions that are seeking innovative ways to manage climate-related financial risks, where improved climate information and index-based insurance approaches can support informed decision-making.

Stakeholders' role

The model relies on collaboration among multiple stakeholders. Farmers were heavily involved in the design processes of both solutions, providing valuable information to ensure contextuality. Their inclusion was facilitated by farmers associations. Insurance companies were engaged to assess the viability of the models used, and research organisations helped develop associated methodologies.

Built-in scalable tools

The model uses tools designed with scalability in mind. The CoDepi tool can be replicated in other contexts since its methodological structure remains constant. Its base parameters must be adjusted to the agronomic, climatic and institutional characteristics of the target region. The Shiny app can be scaled thanks to the fact that the underlying datasets are global in terms of coverage. The tool can even be extended to sectors other than agriculture through the selection of the appropriate climate variables and indicators.

Funding pathways

The pilot case was developed through the Horizon Europe-funded PIISA project, as part of the EU Mission on Adaptation to Climate Change.

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Finance and local economic systems

Risk assessment | Infrastructural resilience | Soil insurance

Adapting to climate change-induced soil instability in Lyon, France

Developing an online dashboard to support homeowners in understanding and assessing clay shrink-swell risks on their property

Climate hazards: **Main themes:**

Lyon, France

Contact: Gregow Hilppa – Hilppa.Gregow@fmi.fi

Key figures

EUR 2.4 – 2.9 billion
spent by France's natural disaster insurance scheme during 2022 droughts

32 municipalities and 38 real estate agencies
approached as dissemination partners

Implementation timeline

2023–2026
PIISA project timeline

Solutions

The PIISA project, funded under the EU Mission on Adaptation to Climate Change, aims to develop innovative insurance and risk-sharing solutions that encourage households, businesses and public authorities to adopt climate adaptation measures and strengthen resilience to climate-related hazards. The Lyon case study within the project develops an insurance-linked decision-support tool which assesses clay shrinkage and swelling (CSS) risks and adaptation options, which occur when clay-rich soils contract during dry periods and expand again during wet periods. Such risks are being exacerbated by climate change, which is causing more prolonged and intense dry and wet periods. Ultimately, the use of the tool enhances household resilience.

1. **Climate dryness index.**
The climate dryness index (CDI) was developed to analyse the combined effect of both drought and heatwaves on soil stability risks. It combines single hazard indices describing precipitation and high temperatures. This data can be used to calculate climate projections and how these may impact CSS events.

2. **Clay shrink swell building damage assessor (CSSBDA).**
The CSSBDA is a web-based assessment platform that was developed and tested in the Lyon region to provide homeowners with information on their exposure to financial risk due to CSS. It is a property-level climate and insurance assessment tool that is designed to extract information scattered across different databases, such as CDI data in relation to climate projections, real estate data and soil risk maps. In this way, the relevant information is presented to homeowners in an intuitive and accessible manner. As a result, it can educate homeowners on the financial risks associated with having inadequate insurance cover for property damage caused by CSS. Apart from this, it also highlights potential coverage gaps and guides homeowners towards taking additional steps for their own protection.

3. **Stakeholder engagement.**
End users were involved in tool development through an inclusive design process. Additionally, continuous feedback from users through specific user testing sessions allowed for tailored improvements and updates to the tool, ensuring that it is suitable for its intended purpose. Targeted outreach was also prioritised, through a direct communication strategy. This strategy combined online engagement, mainly through distributed newsletters and LinkedIn posting, with engagement through local events, such as the 2025 Ethical Finance Forum.



Co-benefits

Economic

The CSSBDA generates economic benefits by helping homeowners identify potential financial exposures associated with CSS damage to residences, before incidents occur. By bridging the awareness gap around such risks, the CSSBDA encourages homeowners to make preventive investments that may reduce future repair costs. In doing so, it helps prevent more severe structural damage and the associated economic losses. The tool also supports more efficient insurance decision-making by highlighting potential coverage gaps and improving homeowners' understanding of such climate-related financial risks.

Social

The CSSBDA delivers important social benefits by drastically improving the public's understanding of CSS risks and the associated insurance protection gaps. In this way, homeowners now gain information that previously proved difficult to obtain and understand, allowing them to make more informed decisions about factors such as property maintenance, risk management and insurance coverage. This also helps households prepare for potential financial shocks caused by CSS damage, allowing them to make informed preparatory financial decisions that protect them from associated quality-of-life disruptions. This is especially relevant since France's national natural disaster compensation system (*régime des catastrophes naturelles*) plays a central role in compensating CSS-related damage. However, compensation depends on the official recognition of a natural disaster event at the municipal level. Many homeowners have limited awareness of how the system operates, the conditions under which compensation is granted and the potential delays or limitations involved.

Environmental

The CSSBDA achieves environmental benefits by encouraging homeowners to adopt preventive adaptation measures. This may in turn reduce future resource consumption associated with major structural repairs, reconstruction activities and waste generation resulting from severe CSS damage.

Replicability – *Who can use this approach and how*

Scaling up the assessment of vulnerable clay areas

Digital assessments strengthening infrastructural resilience in the face of climate-induced clay shrinkage

Best suited for

This model is best suited for regions that experience climate-sensitive geological risks, particularly areas with clay-rich soils that are vulnerable to shrink-swell processes through drought and flood hazards made worse by climate change. While the Lyon pilot focused on CSS damage in France, the model can be transferred to other regions that have reliable data sources such as hazard maps, property information and climate data, in order to enable a seamless integration of available datasets into the system. It is particularly valuable in locations facing increasing climate risks and insurance protection gaps related to residential property damage.

Stakeholders' role

The model relies on collaboration among multiple stakeholders. Core implementation stakeholders included the Sustainable Finance Observatory as the pilot leader, while Amigo SRL played a supporting role in activity testing and feedback. Homeowners, as end users, provided essential feedback on the usage of the CSSBDA. Dissemination targeted other stakeholders for engagement, including real estate agencies and city halls.

Built-in scalable tools

The model was designed to be scalable, with digital, data-driven components that can be adapted to new geographies. The solution was initially tested in Lyon and subsequently is being expanded to national coverage across France through the calculation of the CDI at the national level. This in itself demonstrates its scalability in practice. Its modular structure makes it possible for different data sources from different areas to be integrated depending on local availability.

Funding pathways

The pilot case was developed through the Horizon Europe-funded PIISA project, as part of the EU Mission on Adaptation to Climate Change.

> *'By testing the online dashboard in Lyon, we demonstrated how transparent risk information and accessible communication can empower citizens to better understand their exposure to climate-induced soil instability, fostering both individual and collective adaptation action.'*
>
> **Laura Trentini, data scientist at AMIGO, PIISA project**

PIISA • Deliverable 3.11 • Deliverable 3.5 • Deliverable 3.6 • CORDIS • Mission story

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Finance and local economic systems

Forest sustainability | Insurance

Scaling climate-sensitive forest insurance in the EU: German pilot

PIISA Germany windthrow pilot: an innovative solution to close the protection gap

Climate hazards:

Main themes:

Germany

Contact: PIISA project coordinator, Ilmatieteen Laitos, Finland

Key figures

1–5 %
of German forests insured against windthrow

Windstorms accounted for almost
50 %
of all forest losses in the EU from
1950 to 2019

Implementation timeline

3 years
The PIISA project runs from 2023 to 2026

Solutions [1] [2]

The PIISA (piloting innovative insurance solutions for adaptation) project is a Horizon Europe-funded, three-year initiative that brings together 12 partners from five EU Member States to develop and pilot innovative insurance solutions that incentivise climate adaptation measures. Under the leadership of AXA Climate, the windthrow pilot addresses windstorm risks, the largest contributor to forest loss in the EU at approximately 50 % of all reported disturbance damage between 1950 and 2019. With only 1–5 % of Germany's forest area insured against this risk, the pilot aims to close the protection gap by designing, testing and validating a climate-sensitive insurance solution for windthrow risks through close collaboration with forest owners, insurers and technical partners. The framework has been tested across Denmark, France, Germany, Ireland and Scotland, demonstrating technical robustness and replicability. Key solutions produced by the German windthrow pilot include the following.

[1] PIISA, 'Scalable approach for reducing the gaps in forest wind damage insurance', https://www.piisa-project.eu/assets/docs/PIISA_OnePager_Wind%20Damage.pdf.

[2] Kochar, R., Galizia, L., Voituron, Q., Kaploun, A., Ronfard, B., et al., 'D3.13: Pilots for forests', Zenodo, 27 February 2026, https://doi.org/10.5281/zenodo.20398214.

1. **Forest vulnerability map.**
Incorporates stand-level characteristics such as canopy height, cover, tree density, elevation, wind exposure and slope, refined using machine-learning clustering techniques with model design allowing for updates based on client-specific data availability.
2. **Wind power exposure index (WPEI).**
Built on Copernicus ERA5-Land data, this index provides transparent and replicable climate inputs combining wind speed, wind direction and storm duration to estimate potential windstorm impacts on forest assets.
3. **Windthrow insurance prototype.**
A climate-sensitive insurance solution that combines hazard modelling, stand-level vulnerability assessment and actuarial pricing to provide credible, affordable coverage against windstorm damage with fast, transparent payouts.



Co-benefits ([3]) ([4]) ([5])

Economic

The Germany windthrow pilot aims at achieving several economic co-benefits beyond direct risk coverage. Adaptation measures such as species diversification and structural heterogeneity provide economic value on their own, reinforcing a complementary relationship between adaptation and insurance. The proposed hybrid insurance structure combines index-based pricing with loss assessment, seeking to bridge the gap between product feasibility and attractive pricing. Model outputs serve as risk management tools that help clients make informed coverage decisions. Finally, the insurance can secure cash flows that can complement or compensate for emergency funding, enabling restoration efforts that sustain the long-term economic viability of forestry operations.

Social

The Germany windthrow pilot generates social co-benefits through its stakeholder engagement process and its contribution to livelihood security. The co-design approach, involving six structured workshops with forest owners, insurers and technical experts, fosters trust and ensures the acceptance and relevance of the insurance solution among end-users. Additionally, by securing cash flows for forest recovery and sustaining timber production, the pilot can indirectly protect the livelihoods of forest owners, workers and communities whose economic well-being depends on forestry activities, contributing to the resilience of rural economies exposed to increasing climate risks.

Environmental

The insurance solution can incentivise adaptive forest management practices such as species diversification, structural heterogeneity and uneven age stands, which provide direct ecological benefits beyond risk reduction. By securing cash flows for post-storm recovery, the pilot could support long-term forest ecosystem resilience, helping maintain the carbon sequestration capacity threatened by climate-driven disturbances. Additionally, the model promotes sustainable forestry practices that preserve forest ecosystem services including biodiversity and habitat integrity.

([3]) PIISA, 'Risk indices', PIISA website, 2025, https://piisa-project.eu/tools-risk-indices#storm.
([4]) PIISA, 'Blog – Quantification of forests adaptation measures for insurance application', PIISA website, 26 May 2025, https://piisa-project.eu/quantification-of-forests-adaptation-measures-for-insurance-application.
([5]) Farina, G., Garcia Alvarez, G., Kaploun, A., Kochar, R., Määttä, H. et al., 'PIISA info card 1– Nature-based solutions in the center of climate adaptation', Zenodo, 30 September 2024, https://doi.org/10.5281/zenodo.21410093.

Replicability – *Who can use this approach and how*

Structurally replicable framework

Replicating the windthrow model across the EU with regional calibration and insurer engagement

Best suited for

The replication of the Germany windthrow pilot is best suited for insurance companies willing to integrate the model outputs into their underwriting practice, combined with entities that have access to harmonised forest inventory data and reliable windstorm records. Successful replication requires partners capable of conducting regional calibration and ground-truth validation using historical storm events before any product contractualisation takes place, as replication without local calibration significantly reduces accuracy. The framework can be deployed across EU forested areas with comparable forest and storm characteristics, since the WPEI uses globally available ERA5-Land data, though adaptation to local ecological and regulatory contexts remains essential.

Stakeholders' role

The Germany pilot developed its solutions through close collaboration among insurers, private forest owners, climate-service providers and technical partners, ensuring their engagement in co-design workshops. To replicate the solution elsewhere, continued collaboration between insurers, forest owners, public authorities and climate service providers is required. Successful replication depends on insurer engagement to integrate model outputs into underwriting, access to harmonised forest inventory and stand-level data, and local actors to conduct regional calibration and ground-truth validation before contractualisation.

Built-in scalable tools

The key replicable elements include the WPEI, built on globally available ERA5-Land data requiring no structural redesign, and the forest vulnerability index, which incorporates stand-level characteristics. The combined modelling architecture integrating hazard, vulnerability and actuarial simulations is designed for scalability across EU regions with comparable forest and storm characteristics. The historical hazard component of the WPEI can also be deployed independently as a climate service. These technical components are transferable, though they require integration with local forest inventory data and regional ground-truth calibration to maintain accuracy in new contexts.

Funding pathways [6]

The PIISA project was funded through Horizon Europe under grant agreement number 101112841.

This solution is part of Mission Solutions Catalogue

[6] European Commission, 'Piloting innovative insurance solutions for adaptation', European Commission website, https://cordis.europa.eu/project/id/101112841.

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Finance and local economic systems

Nature-based solutions | Green rooftops | Insurance

Insurance solutions for climate adaptation

Enhancing climate resilience through insurance-backed green roof uptake

Climate hazards:

Main themes:

Netherlands

Contact: Ilmatieteen Laitos, Finland (PIISA project coordinator)

Key figures

Approximately
2 000
Dutch residents surveyed

Additional surveys also in
Scandinavian
and
Mediterranean
countries, allowing for comparison

Implementation timeline

2023–2026
PIISA project timeline

Solutions

The PIISA green roof pilot explores how the insurance sector can accelerate the uptake of nature-based solutions (NBS) by rewarding climate-resilient investments. Focusing on green roofs, the project assesses how insurers can encourage adaptation through financial incentives, better risk assessment and innovative insurance products. The approach was tested across three European contexts the Netherlands, Scandinavia and the Mediterranean region, to compare different climate, market and regulatory conditions. Based on surveys, stakeholder engagement, economic experiments and a cost–benefit analysis, the pilot aims to identify the barriers to and enablers of integrating green roofs into insurance practices, evaluate the economic case for green roofs and generate evidence for a future European insurance business model that supports NBS. The main results from the Dutch analysis are the following.

1. **Identification of barriers.**
The project identified the main barriers preventing insurers from supporting NBS. These include the lack of a clear business case, limited awareness of climate risks, fragmented responsibilities between sectors, uncertainty over insurers' roles and regulatory constraints.

2. **Identification of enablers.**
The project also identified practical ways in which insurers can encourage the uptake of green roofs. These include offering reduced insurance premiums for buildings equipped with NBS, providing advice on climate risk prevention, expanding insurance coverage for nature-based measures and applying 'build back better' principles after disasters so that damaged properties are rebuilt with greater climate resilience.

3. **Cost–benefit analysis.**
The cost–benefit analysis showed that the value of green roofs increases significantly when broader societal benefits – such as flood reduction, improved health, urban cooling and well-being – are included alongside direct financial returns. This strengthens the case for public support and innovative insurance models that recognise these broader benefits.



Co-benefits

Economic

The project shows that green roofs generate value well beyond individual buildings. They reduce flood damage, lower adaptation costs, improve public health, increase urban liveability and create broader societal benefits that are not usually reflected in traditional insurance models. Recognising these benefits strengthens the economic case for insurers, cities and policymakers to invest in NBS.

Social

In the PIISA project, green roofs were found to generate important social co-benefits alongside their environmental functions, particularly by supporting well-being, liveability and community resilience. Green roofs contribute to healthier, more attractive and more liveable cities. By reducing heat stress, improving neighbourhood aesthetics and lowering flood risk, they enhance quality of life while strengthening communities' sense of safety and resilience. In addition, by helping to reduce flood risk, green roofs can strengthen community resilience and contribute to a greater sense of safety and preparedness in the built environment.

Environmental

The PIISA project highlights that green roofs provide several environmental co-benefits. They help manage rainwater by retaining and slowing run-off, which can reduce pressure on urban drainage systems and support pluvial flood mitigation. They also contribute to cooling in cities, helping to reduce heat stress and improve urban liveability as temperatures rise. In addition, green roofs can support drought resilience and broader urban nature-based adaptation by improving water retention and contributing to more climate-resilient urban environments. Together, these benefits make green roofs effective NBS for increasing urban climate resilience.

Replicability – *Who can use this approach and how*

Learning from the Netherlands

Using insurance to unlock investment in nature-based solutions

Best suited for

This model is particularly relevant for insurers, reinsurers, public authorities and cities seeking innovative ways to finance climate adaptation. It is especially valuable where urban flooding and heat are increasing and where insurance can help reward resilient investments such as green roofs.

Stakeholders' role

Successful replication requires close cooperation between insurers, public authorities, urban planners, researchers, property owners and the climate adaptation community. Each stakeholder contributes to building the evidence, designing the incentives and creating the regulatory and financial conditions needed to scale NBS.

Built-in scalable tools

The project provides a transferable framework that combines stakeholder engagement, behavioural research, a cost–benefit analysis and real-world insurance testing. This evidence-based approach can be adapted to different insurance markets and regulatory environments, helping other regions develop financial incentives for NBS.

Funding pathways

The pilot was developed through the Horizon Europe-funded PIISA project under the EU Mission on Adaptation to Climate Change. By demonstrating how insurance products can reward climate-resilient investments, the project opens new opportunities to mobilise private finance alongside public funding, creating innovative public–private partnerships that accelerate the uptake of NBS.

Pilot 1 • PIISA factsheet • Deliverable D3.11 • Incentivising green roof adoption through insurance • Enablers and barriers • Dutch insurers need best practices and partnerships • CORDIS

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Finance and local economic systems

Wildfire management | Insurance | Incentives

PIISA's approach to wildfire risk reduction through insurance innovation

Quantifying adaptation benefits and premium incentives in central Portugal

Climate hazards:

Main themes:

Caramulo and Ribeira de Mega regions, Portugal

Contact: PIISA project coordinator, Ilmatieteen Laitos, Finland

Key figures

10 %
of wildfire losses between 1990 and 2019 were covered by insurance in Portugal

12
partners from

5
EU Member States joined PIISA

Implementation timeline

3 years
The PIISA project spans from 2023 to 2028

Solutions

PIISA (piloting innovative insurance solutions for adaptation) is a Horizon Europe project developing climate-resilient insurance portfolios and solutions for sharing climate-related risk data. The project focuses on sectors including agriculture, forestry and cities, addressing hazards such as floods, droughts, forest fires, biotic risks and storms. Within this framework, one of the project pilot cases targets wildfire risks in the Caramulo and Ribeira de Mega regions of central Portugal. In these regions, wildfires are a recurrent threat to property and forests, insurance uptake remains limited and the most fire-prone areas risk becoming uninsurable. The pilot's objective is to integrate climate change adaptation measures, specifically fuel management networks derived from Portugal's national adaptation plan, into parametric wildfire insurance design, allowing risk reduction efforts to be explicitly modelled and priced for the benefit of households, forest owners and communities. In this regard, the case study put forward the following solutions.

1. **An integrated wildfire risk modelling framework that links adaptation measures to insurance pricing.**
The pilot developed a technical solution comprising calibrated fire-spread models (MTT and WISE) that incorporate Portugal's national adaptation plan fuel-break scenarios and adaptation options. This framework quantifies how implemented adaptation measures, for instance fuel breaks, reduce burn probability and economic losses, enabling insurers to offer premium reductions of 70–95 % for forests and 80–84 % for buildings in in scenarios where those those measures are implemented. By mathematically validating the effectiveness of forest management and nature-based solutions, this model creates financial incentives for landowners to adopt risk-reducing practices.



Co-benefits

Economic

The PIISA Portugal wildfire pilot suggests that integrating adaptation measures into insurance design delivers measurable economic value for forest owners, households, and communities. By validating fuel-break networks through calibrated fire spread models, the study quantified how maintained prevention measures lower risk, enabling premium reductions of up to 95 % for forest coverage and 84 % for building exposure. These reductions address the significant protection gap in Portugal, where only approximately 10 % of wildfire losses were insured between 1990 and 2019, by making coverage more affordable and ensuring continued insurability under worsening climate conditions.

Social

The Portugal wildfire case study aims at achieving social co-benefits by enhancing community safety and governance through the implementation of primary and secondary fuel management networks that protect infrastructure, social facilities and built-up areas from fire spread. By fostering structured collaboration between public authorities such as the Agency for the Integrated Management of Rural Fires, municipal representatives and forest producer associations, the pilot strengthened multi-stakeholder governance and ensured adaptation measures reflect local operational realities. The production of burn probability maps further empowers local authorities and land managers with evidence-based tools for emergency planning and risk-aware decision-making.

Environmental

The Portugal wildfire case study delivers significant environmental co-benefits by safeguarding long-term carbon sequestration capacity and preserving ecosystem integrity. By modelling how fuel management networks reduce fire frequency and intensity, the pilot suggests that effective risk mitigation prevents the rapid reversal of accumulated carbon stocks, stabilising forest carbon assets and enhancing the durability of carbon sequestration outcomes. Additionally, reducing severe fire damage helps protect biodiversity and critical ecosystem services, such as soil stability and water regulation, that are otherwise undermined by large-scale burns.

Replicability – *Who can use this approach and how*

Replicating Portugal's approach

Transferable models, pricing frameworks and governance workflows for Mediterranean regions

Best suited for

National public authorities – particularly fire management agencies with existing adaptation frameworks – and insurers capable of offering parametric products are best suited to replicate this solution, working in partnership with forest owner associations and research technical partners. The pilot identifies Mediterranean regions facing structural wildfire risk, specifically Greece, Spain, southern France and Italy as prime candidates, where stakeholders including insurance associations, forest producers and municipal authorities have already demonstrated an interest in quantifying risk reduction benefits to lower premium costs and align with national adaptation plans.

Stakeholders' role

Successful replication requires a collaborative model in which public authorities provide regulatory clarity and adaptation policy support, insurers integrate calibrated risk models into underwriting to offer verified premium reductions and forest managers implement maintained fuel-break networks, ensuring strong institutional coordination and local data calibration.

Built-in scalable tools

The Portugal wildfire pilot embeds several transferable components. The core element is the modelling framework for wildfire spread calibrated against satellite data and historical fire events, which can be recalibrated for new regions using local data. Within these models, a standardised methodology codes different adaptation options, enabling any region with defined prevention strategies to simulate and quantify risk reductions. These modelled reductions feed directly into a parametric insurance pricing framework that translates burn probability decreases into concrete premium discounts, providing a replicable template for insurers to monetise adaptation. Finally, the co-development workflow established with national authorities, forest associations and municipalities offers a governance model for validating solutions and ensuring local ownership when replicating in new Mediterranean contexts.

Funding pathways

The PIISA project was funded through Horizon Europe under grant agreement number 101112841.

Pilot 5 • PIISA_OnePager_Wildfire_V3 •
Quantification of forests adaptation measures for insurance application •
PIISA_D3.13_Pilots-for-forests.pdf • PIISA_D4.7_Replicability-Roadmap.pdf • CORDIS EU

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Finance and local economic systems

River catchments | Phosphate pollution | Nutrient credits

The bankability of nature-based solutions in the West Country, United Kingdom

Mobilising private finance to scale up climate adaptation through innovative nature-based solutions on rural land

Climate hazards:

Main themes:

West Country, United Kingdom

Contact: Westcountry Rivers Trust, United Kingdom
Nicola Rogers – nicolarogers@wrt.og.uk
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Key figures

49
barriers to green finance identified

Nature-based solutions in 2
major water catchments

Implementation timeline

2021–2025
TransformAr project timeline

Budget

EUR 17 500 – 35 000
per site

Solutions

TransformAr develops and tests innovative approaches to climate adaptation that can be replicated across Europe. In the West Country (United Kingdom), the project focused on improving water management in the Axe and Camel river catchments by combining nature-based solutions (NBS) with innovative financing mechanisms. Together, these approaches reduced flood risk, improved water quality and created sustainable investment models for long-term climate resilience. This was done through the following NBS and finance-based measures.

1. **Nature-based solutions.**
Within the Axe catchment, NBS in the form of sediment traps and scrapes were implemented with the aim of intercepting run-off containing high levels of phosphates before it reaches the water body. Additionally, leaky dams were installed in both the Axe and Camel catchments within permanent streams to slow down water flow and allow sediments and nutrients to settle. Together, these interventions slow water flow, reduce nutrient pollution, improve water quality, restore habitats and strengthen the resilience of the river catchments to climate change.

2. **Engagement for green finance.**
The project explored how private investment can help finance NBS. Through interviews and stakeholder workshops, it identified the main barriers to green finance, including investor risk aversion, and tested practical solutions. One promising approach is the creation of community interest companies, enabling businesses and local organisations to pool resources to finance wetlands, ponds and other NBS. Demonstrating the multiple benefits of these interventions, such as improved water quality, reduced flood risk and healthier ecosystems, also helps strengthen the investment case.

3. **Nutrient credit schemes.**
The nutrient credit scheme provides an innovative market-based funding mechanism. Housing developers purchase nutrient credits to offset the impacts of new developments, generating revenue that finances NBS to reduce phosphorus pollution. This creates a self-sustaining financing model that simultaneously supports water quality, biodiversity, carbon storage and flood resilience.

Co-benefits

Economic
The demonstrator reduces the long-term costs of flooding, poor water quality and nutrient pollution through affordable, nature-based solutions. It also pioneers innovative financing models, including community interest companies and nutrient credit schemes, that attract private investment and reduce reliance on public funding while supporting sustainable economic development.

Social
The project strengthens collaboration between public authorities, businesses, landowners and local communities by increasing awareness of the value of healthy river ecosystems. Restored rivers and wetlands improve landscape quality, create recreational opportunities and support local well-being while helping farmers, water companies and housing developers better manage climate-related risks.

Environmental
By increasing hydraulic residence time and increasing nutrient and sediment retention, NBS improve water quality by reducing nutrient pollution and preventing eutrophication, one of the main causes of biodiversity loss in freshwater ecosystems. They also restore wetlands, increase water retention, reduce flood risk and strengthen the overall resilience of river catchments to climate change.

Replicability – *Who can use this approach and how*

Scaling up nature-based solutions and their investment

How to finance nature-based solutions at catchment scale

Best suited for

This model is particularly suitable for river catchments facing increasing flood risk, drought, nutrient pollution and water quality challenges. It is especially relevant where public authorities and local stakeholders are seeking innovative financing mechanisms to scale up NBS.

Stakeholders' role

The approach combines local coordination by river basin organisations with scientific expertise, while actively engaging businesses, public authorities, landowners, developers and community organisations. This collaborative governance model helps ensure that both technical solutions and financing mechanisms reflect local needs.

Built-in scalable tools

The model combines transferable NBS with innovative financing mechanisms and stakeholder engagement methods. Community interest companies, nutrient credit schemes and participatory workshops can all be adapted to different river basins, providing a practical framework for scaling up climate adaptation while mobilising new sources of investment.

Funding pathways

The demonstrator was developed through the Horizon Europe-funded TransformAr project, as part of the EU Mission on Adaptation to Climate Change. By testing innovative financing mechanisms alongside NBS, it demonstrates how public funding can help unlock long-term private investment for climate adaptation and river restoration.

Mission story • **TransformAr** • **Mission projects catalogue** • **Deliverable 1.1** • **CORDIS**

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Cross-cutting

Twinning regions | Transferable climate adaptation | Collaborative approaches

Replicating climate adaptation across Europe with the EU-funded Resist project

The use of twinning regions to enhance Europe's transferable resilience in the face of climate change

Climate hazards: **Main themes:**

Europe-wide (12+ regions in Denmark, Spain, Latvia and beyond)

Contact: Dr Vilija Balionyte-Merle – vilija.balionyte-merle@sintef.no
Project coordinator

Key figures

12
twinning regions for sharing solutions

100+
adaptation solutions tested and refined by the Resist team

EUR 26 million +
total project funding

Implementation timeline

2023–2027
Resist timeline

Solutions

The Resist project, funded under Horizon Europe as part of the EU Mission on Adaptation to Climate Change, is delivering concrete, scalable results to strengthen climate resilience across 12 highly vulnerable European regions. Through large-scale real-world demonstrations, the project is not only testing innovative adaptation solutions, but also also actively accelerating their uptake, market readiness and replication across Europe. More than 100 adaptation solutions are being advanced, while citizens, policymakers and regional stakeholders are directly engaged in reducing climate risks and economic losses.

1. **Twinning regions – turning local success into European impact.**
   Resist connects regions facing similar climate challenges through a powerful twinning model: leading demonstrator regions work hand in hand with replicating regions. This approach is proving highly effective: solutions tested in one region are rapidly adapted and transferred to others, turning local innovation into fast, structured Europe-wide scaling up of climate resilience.
2. **Nature-based solutions – greening cities with measurable impact.**
   Nature-based solutions are delivering visible and measurable benefits on the ground. Tools like the blue-green factor, developed in Southwest Finland and now adopted in regions such as Normandy in France, and East Macedonia and Thrace in Greece, are transforming urban planning by systematically embedding green and blue infrastructure into development decisions.
   Complementary cost–benefit analysis tools are helping regions demonstrate that not only are nature-based solutions environmentally sound, they are also economically smart and resilience-boosting investments.
3. **Digital tools – smarter, faster, data-driven adaptation.**
   Resist is bringing adaptation into the digital age with powerful decision-support and simulation tools. Platforms such as BEST Adapt, already in use in Central Denmark, and XR Pathfinder, co-developed by Central Denmark and Blekinge, are being transferred to Vesterålen, enabling stakeholders to test climate futures, compare adaptation options and make evidence-based decisions with confidence. Meanwhile, internet-of-things-based groundwater monitoring systems deployed in central Denmark and Zemgale provide real-time environmental intelligence, strengthening preparedness for droughts and floods and improving water management on a regional scale.
4. **Stakeholder engagement – from awareness to co-creation.**
   Resist is redefining participation by making adaptation tangible and interactive. Through extended reality tools, stakeholders can now visualise future climate impacts and planned interventions before implementation. This shifts engagement from consultation to true co-design, improving trust in, understanding of and acceptance of adaptation measures.

Co-benefits

Economic

The Resist project helps regions take proactive action to avoid costly future climate damage. By investing early in adaptation, regions reduce financial losses linked to climate hazards and strengthen long-term economic resilience. In Extremadura (Spain), for example, natural wildfire barriers are helping protect agricultural land and reduce losses from wildfires. Beyond risk reduction, Resist also creates new local economic opportunities, particularly through the skills and jobs needed to design and implement adaptation measures, turning resilience into a driver of regional development.

Social

Resist puts collaboration at the centre of adaptation. It promotes early co-creation between researchers, local authorities, businesses and other stakeholders, ensuring solutions are practical and locally grounded. In several case studies, extended reality tools are also used to help citizens and stakeholders visualise planned measures, improving understanding, trust and acceptance.

Environmental

The project delivers ecosystem-based solutions that strengthen environmental resilience to climate hazards. Many measures work with nature to reduce risks such as heatwaves, droughts and wildfires. In Spain and Portugal, for instance, wildfire-resilient landscaping helps slow fire spread, protecting ecosystems and biodiversity while also reducing emissions from uncontrolled fires. Across regions, these approaches show how healthy ecosystems can act as a first line of defence against climate impacts.

Replicability – *Who can use this approach and how*

Resist's scalable model

Resist is designed as a replicable and scalable adaptation framework, enabling regions across Europe to adopt and adapt tested solutions in real conditions

Best suited for

The approach is particularly relevant for regions that share similar climate hazards and environmental conditions, even if they are geographically distant. This allows solutions to be transferred effectively between contexts facing comparable risks such as floods, droughts, heatwaves and wildfires.

Stakeholders' role

Scalability is built on multilevel, collaborative governance. Key stakeholders include regional and municipal authorities, EU mission coordination structures, researchers and academia, along with private-sector partners. This partnership model ensures that solutions are co-developed, tested and implemented with strong local ownership and scientific backing.

Built-in scalable tools

At the core of Resist is the twinning region approach, which functions as an in-built upscaling mechanism. It connects leading demonstrator regions with replicating regions, enabling tested solutions to be rapidly adapted, transferred and deployed across borders.

Funding pathways

Scaling up under Resist is supported through a combined funding approach that brings together both regional and EU resources. This blended model ensures that solutions can be tested locally while also being transferred and expanded across borders. The total budget of the project is EUR 26 682 827.75, of which EUR 24 949 990.25 is provided by the EU. This significant EU contribution helps ensure that regions have the financial capacity to implement, upscale and sustain innovative adaptation measures.

> *'We want the tools, strategies and knowledge we develop to keep helping communities adapt to the challenges brought by climate change.'*
>
> **Vilija Balionyte-Merle, Resist Project Coordinator, SINTEF, Norway**

Horizon magazine • **Resist CORDIS** • **Resist webpage** • **GitHub**

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Cross-cutting

Integrated wetland management | Ecosystem restoration | Hybrid approaches

Integrated wetland management for flood resilience and environmental protection

A regional approach to restoring wetlands, reducing flood risk and strengthening environmental resilience

Climate hazards:

Main themes:

Oristano, Italy

Contact: Universiteit Antwerpen, Belgium (TransformAr project coordinator), Mediterranean Sea and Coast Foundation, Italy (Demonstrator coordinator)
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Key figures

7 700 ha
of protected areas, including
6 Ramsar sites, 16 sites of community importance

and

9 special protection areas
Three stations
for multiparametric data gathering

Implementation timeline

2021–2025
TransformAr project timeline

Budget

Approx. **EUR 300 000**

Solutions

TransformAr's demonstrator 4 focuses on the integrated management of the Oristano coastal wetland system in Sardinia, Italy, with the aim of reducing flood risk while improving ecological conditions. The system comprises a brackish lagoon and a pond, the salinity of which is influenced by freshwater inflows from surrounding rivers. The area is internationally recognised under the Ramsar Convention and forms part of the Natura 2000 network. The two basins are separated by an embankment, and an overflow basin has been created at the river mouths. The solutions developed under this demonstrator are the following.

1. **Coastal contract.**
It is a voluntary governance and planning framework for the Oristano coastal wetland system in Sardinia. It brings together public authorities, site managers, local communities and other stakeholders to agree on shared priorities for the integrated management of this internationally important wetland area. Its purpose is to improve coordination and integrated governance across the wider lagoon–coastal system, support climate adaptation and resilience and align measures on biodiversity conservation, water management and local socioeconomic uses.

2. **SmartGate.**
Part of a larger project funded by the region through the European Regional Development Fund (ERDF), it is a remote-controlled gate made of stainless-steel movable components that allow the gate to open automatically, depending on several conditions. These conditions, defined through multidisciplinary meetings, are safety thresholds for water levels at river mouths, water quality parameters, adverse weather forecasts and seasonal water renewal. This intervention aims to regulate water flow between freshwater inputs from rivers and the brackish waters of the pond, reconnecting wetland areas that were previously separated by human interventions and restoring the natural water balance.

3. **Sensor-based environmental monitoring.**
The SmartGate operates based on data gathered through a network of multiparametric sensors (measuring temperature, pH, dissolved oxygen, conductivity, turbidity and redox potential) and level gauges distributed across three different stations. Each station includes a data logger capable of transmitting information and a solar panel for autonomous power. The monitoring network is complemented by a weather station, which measures air temperature, wind speed and direction, relative humidity and precipitation. Together, these systems constantly monitor water quality and environmental conditions, providing up-to-date data that enables adaptive hydraulic management, with all parameters measured in real time.

4. **Data platform.**
Data is collected every 30 minutes and fed to a centralised platform, where it is integrated by management software enabling remote control. In addition, a geoportal enables consultation of historical data and downloading of raw or processed data.

Co-benefits

Economic

In TransformAr's demonstrator 4, the Oristano coastal wetland system is expected to generate economic co-benefits by reducing flood-related damage and improving the long-term viability of local livelihoods linked to fishing, aquaculture, agriculture and nature-based tourism. The SmartGate, testing a new management model, supports these benefits by helping to manage water levels more effectively, which can protect productive activities and wetland ecosystem services while improving ecological conditions.

Social

The project supports more inclusive and participatory governance by bringing together stakeholders involved in wetland management, thereby helping public authorities, local communities and economic actors cooperate more effectively. The innovations also help protect local livelihoods, particularly those linked to fishing, aquaculture and agriculture, by improving water management and creating a clearer governance framework. In this way, they contribute to the social and economic stability of the area. At the same time, they strengthen community resilience to climate risks, by supporting adaptation to changing environmental conditions and helping local actors prepare for future pressures. Because these measures are developed through cooperation and dialogue, they can also improve the social acceptance and legitimacy of adaptation activities.

Environmental

In TransformAr's demonstrator 4, the SmartGate and the coastal contract can generate important environmental co-benefits by improving the adaptive management of water exchanges and supporting more coordinated ecosystem governance. Better control of salinity and water levels can help maintain lagoon and wetland ecological conditions, which is beneficial for habitats and biodiversity, while also strengthening the system's resilience to climate pressures such as sea-level rise and storm surges, heavy precipitation and heatwaves. At the same time, the coastal contract can encourage cooperation among local stakeholders, helping align land, water and coastal management in ways that support the long-term ecological quality of the wetland system.

Replicability – *Who can use this approach and how*

A transferable methodology for coastal wetland management

An integrated, adaptable approach to coastal wetland management that combines socio-ecological assessment, adaptive governance and co-designed measures

Best suited for

The TransformAr project's approach to integrated coastal wetland management is most readily transferable to coastal wetland systems such as deltas, lagoons and estuaries, where public authorities, environmental managers and local stakeholders can work together through adaptive governance. The most suitable replicators are coastal or wetland management bodies, municipalities with land-use and water-regulation responsibilities, protected area administrators and multi-actor partnerships able to connect technical expertise with participatory planning.

Stakeholders' role

In the TransformAr project, integrated coastal wetland management involves a broad set of stakeholders brought together through a multi-actor approach. These include public authorities and policymakers, environmental and water managers, scientists and technical experts, and local stakeholders such as land users, community representatives and civil-society organisations. Change to through the use of adaptation pathways covering agriculture and fisheries, biodiversity protection and settlements, allowing allow stakeholders to look toward the future, considering the action needed to adapt to evolving climate scenarios.

Built-in scalable tools

TransformAr's replicable methodology for integrated coastal wetland management combines adaptive governance with a robust socio-ecological vulnerability assessment to help coastal regions respond to climate risks in a flexible and context-sensitive way. By integrating technical measures, such as ecosystem restoration and risk reduction interventions, with governance tools, including stakeholder coordination, planning and participatory decision-making, the approach supports more resilient, integrated and transferable wetland management across different coastal settings.

The SmartGate and monitoring system's effective upscaling and long-term sustainability require the early definition of governance and maintenance models. This includes clearly assigning responsibilities for system management, integrating monitoring data into local decision-making processes and implementing a well-structured maintenance plan that encompasses regular cleaning, calibration and verification activities to ensure the system's continued reliability and performance. The SmartGate and monitoring system implemented during the TransformAr project is fully operational. A one-year testing phase provided early evidence to define an effective maintenance plan, ensuring system reliability and data quality through regular sensor cleaning (every 30 days in winter and every 15 days in summer) and annual sensor recalibration, or as recommended by the manufacturer. Monitoring results also identified water temperature and dissolved oxygen as the key parameters driving gate opening and closing. The pilot project's success attracted additional funding to replicate the system along the embankments within the lagoon. It also led to the update of the coastal contract action plan with the inclusion of new monitoring and hydraulic management actions to be implemented in other ponds and lagoons across the area, funded by the Regional River Basin Authority.

Funding pathways

The overall cost of the intervention was approximately EUR 300 000, funded through the Horizon Europe project TransformAr under the EU Mission on Adaptation to Climate Change. In addition, several interventions were co-funded by private-sector institutions.

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Cross-cutting

Community-led climate-resilient scalable

Community-driven local action for food security and climate resilience in northern Hungary

Climate-resilient gardens: a participatory model for rural adaptation and self-sufficiency

Climate hazards:

Main themes:

North Hungary

Contact: Anna Mészár – anna@magosvolgy.hu

Key figures

13 400 km²
rural region

1.2 million inhabitants,
mostly in small villages

Implementation timeline

Since 2023

A budget of

EUR 40 000 to EUR 50 000
for municipal gardens and mentoring support for citizens

Solutions

Hungary's rural communities, which rely heavily on agriculture and natural resources, with limited funding, policy gaps and decreasing traditional knowledge, face growing climate risks, compounded by an ageing population struggling to pass on local expertise to newcomers. In response, the EU LIFE (programme for the environment and climate action) Co-Clima project implemented community-driven solutions to rebuild resilience, bridge generational gaps and secure sustainable livelihoods in the face of climate change, through the following solutions.

1. **Biointensive vegetable gardens.**
Vegetable gardens have been established by local municipalities to boost communities' food security. These small-scale but highly productive gardens are designed to grow the maximum ammount of food in minimal space using natural, sustainable methods, such as cultivating healthy soil without chemicals. Beyond food production, they act as community hubs, learning centres and demonstration sites, fostering hands-on education in ecological gardening.

2. **Participatory learning.**
The project engages with communities through practical, participatory activities to build climate-resilient gardening skills. Hands-on demonstrations, such as compost mulching, wood mulching and permanent bed gardening, teach sustainable techniques, while targeted workshops cover critical topics like water management and biodiversity. Experienced biointensive gardeners provide one-on-one mentorship, ensuring knowledge transfer, and community events, including cooking competitions and open garden days, foster shared learning, social connection and celebration of local, sustainable food practices.

3. **Community resilience programme.**
The community resilience programme was developed based on a survey of local inhabitants' needs, ensuring solutions align with real challenges. It includes capacity-building workshops on sustainable lifestyles and ecological gardening, personalised mentorship from experienced gardeners and community events centred on healthy, sustainable food. To encourage participation, financial incentives help residents transition to more ecological gardening and household practices.

4. **Institutional capacity building.**
The project strengthened collaboration between local authorities, experts and residents to co-develop climate adaptation strategies. It created practical guidelines to embed community-based solutions into local planning frameworks, while knowledge-sharing networks ensured that grassroots experiences could inform broader regional and national adaptation policies. This approach bridges local action with systemic change.

Co-benefits

Economic
The project's biointensive gardening and sustainable practices deliver key economic co-benefits by lowering household food costs through increased self-sufficiency and food security. Meanwhile, community events like open garden days and cooking competitions stimulate local economic activity by attracting visitors, fostering small-scale trade and promoting agrotourism, thereby strengthening rural livelihoods in a changing climate.

Social
The project fosters social cohesion and empowerment by transforming community gardens into shared learning hubs, where experienced residents mentor newcomers in sustainable gardening, preserving traditional knowledge while adapting to modern challenges. Through workshops, mentorships and events such as cooking competitions and open garden days, the project strengthens social networks, reconnects people with nature and builds collective resilience. By involving local authorities, experts and residents in collaborative adaptation efforts, the initiative revitalises cultural practices and fosters a sense of belonging and mutual support.

Environmental
The project delivers measurable environmental co-benefits by promoting ecological gardening and food processing through natural and sustainable methods, thus enhancing soil health. Through water-efficient techniques and biodiversity-focused workshops, it strengthens ecosystem resilience against droughts and extreme weather. By scaling up community-led adaptation models, the initiative also supports broader regional sustainability, ensuring long-term environmental protection alongside climate resilience.

Replicability – *Who can use this approach and how*

A scalable model for rural local food security

Adapting the community resilience programme across Europe's small villages

Best suited for

This project is best suited for replication in small rural villages, with lower adaptive capacity to face climate threats like droughts and extreme weather. It is especially relevant for municipalities with ageing populations, where traditional ecological knowledge risks being lost, and communities reliant on agriculture or natural resources but lacking policy or financial support. The model thrives where local authorities, experts and residents collaborate, making it adaptable for other rural areas.

Stakeholders' role

The project engages a diverse range of stakeholders, including local municipalities that establish and manage biointensive gardens, residents and experienced gardeners who provide mentorship. Local authorities and experts collaborate to integrate climate adaptation into planning, while the EU LIFE programme provides the primary funding. Additionally, community networks actively participate in workshops, events and knowledge-sharing, ensuring broad involvement in building resilience.

Built-in scalable tools

The project's built-in upscaling tool is its community resilience programme, a structured, annually renewable model combining workshops, mentorship and financial incentives to support ecological gardening. Designed for replication, it provides a practical framework that other rural communities can adopt to strengthen climate resilience, food self-sufficiency and local adaptation efforts.

Funding pathways

The project is funded by the EU LIFE programme. This funding supports the implementation of community-based climate adaptation solutions, including biointensive gardens, workshops, mentorship programmes and institutional capacity building. The financial incentives provided to residents for transitioning to ecological practices are also part of this funding framework.
The vegetable garden project was funded with a total of EUR 1 746 561, 60 % of which was received from the LIFE programme and the remaining EUR 698 624 from the Hungarian government. The initial cost for the implementation of the municipal gardens and mentoring support for citizens was estimated as being between EUR 40 000 and EUR 50 000.

> *'The LIFE Co-Clima model is developed to help small rural settlements in their climate adaptation efforts. We aim to promote community resilience, raise climate awareness, improve the self-sufficiency of residents in food security, strengthen their livelihood strategies and long-term health.'*
>
> **Anna Mészár, Co-Clima Project Manager**

Mission story • **LIFE3.0** • **VegetableGardens**

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Cross-cutting

Cross-regional | Data-driven | Just transition

Building climate resilience in Baixo Alentejo, Portugal

From emergency response to proactive resilience

Climate hazards: **Main themes:**

Baixo Alentejo, Portugal

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Key figures

Over 75 %
of the territory presents
high risk of desertification

2–4 °C
projected increase in
average temperatures by
the end of the century

Around
10 % reduction in average annual precipitation
(≈43 mm/year)

Implementation timeline

2023–2027
Resist timeline

Solutions

Baixo Alentejo is strengthening its climate resilience through innovative adaptation solutions developed as part of the Resist project, funded by the EU Mission on Adaptation to Climate Change. By combining digital decision-support tools, community participation and cross-regional learning, the region is enhancing preparedness, protecting rural landscapes and building long-term resilience against heatwaves, wildfires and desertification. Key solutions include the following.

1. **Argos Warning System.**
The Argos platform empowers emergency managers with smarter, faster decision-making processes by monitoring high temperatures and heatwaves, analysing past events, identifying vulnerable hotspots and guiding preventive actions outlined in the intermunicipal plan for adaptation to climate change of Baixo Alentejo.

2. **Citizen participatory toolkit.**
The citizen participatory toolkit places citizens at the centre of climate resilience by promoting inclusive participation and collaboration between communities, civil-society organisations and public authorities in addressing natural hazards, climate change and civil protection challenges.

3. **Integrated areas for landscape management (AIGP).**
The AIGP pilot translates EU priorities into concrete territorial action, promoting collective and sustainable management of agroforestry landscapes in high-fire-risk areas. By combining community stewardship and sustainable land management, the pilot aims to reduce wildfire risks and strengthen the resilience of landscapes and ecosystems.

4. **Graphic digital twin.**
The graphic digital twin supports smarter, data-driven governance by enabling authorities and stakeholders to better visualise risks, coordinate action and strengthen engagement across the region.

Co-benefits

Economic

The project generates strong economic co-benefits by reducing long-term emergency response and recovery costs through proactive adaptation and early warning systems like Argos. It also attracts additional public investment beyond EU funding, showcasing how climate resilience can stimulate regional development and unlock new financing opportunities. The AIGP approach enhances the value of natural capital through sustainable agroforestry and land management, creating opportunities for greener local economies. At the same time, the twin region knowledge transfer model reduces development costs by adapting tested solutions instead of building systems from scratch, offering an efficient and scalable pathway for other regions.

Social

The project strengthens inclusive climate governance by actively involving citizens, local authorities and civil society in resilience planning through tools such as the citizen participatory toolkit. It improves public safety by strengthening preparedness for heatwaves and wildfires, helping to protect vulnerable populations while fostering a shared sense of responsibility for rural landscapes. By promoting collaborative land management and nature-based solutions, the initiative also reinforces community cohesion, improves quality of life and supports long-term rural sustainability. Rooted in just transition principles, the project ensures that climate adaptation remains fair, participatory and community driven.

Environmental

The project delivers major environmental co-benefits by tackling climate risks through sustainable land and water management. The helps combat desertification through collective agroforestry practices that improve soil health, strengthen biodiversity and enhance ecosystem resilience.

Replicability – *Who can use this approach and how*

Replicating Baixo Alentejo's climate resilience model

Scalable tools, stakeholder engagement and funding strategies for vulnerable regions

Best suited for

This model is best suited for regions facing multiple climate risks, particularly drought-prone and wildfire-sensitive areas in southern Europe and the Mediterranean. It is especially relevant for rural and agroforestry territories where extreme heat, water scarcity and ecosystem degradation threaten livelihoods, biodiversity and public health. The approach supports regions and local authorities seeking to move from reactive emergency response to proactive, data-driven climate adaptation while strengthening community resilience and sustainable land management.

Stakeholders' role

Strong regional coordination is essential for connecting municipalities, civil protection services and local action on the ground. Landowners, farmers and estate managers play a key role in testing and scaling up nature-based solutions for wildfire prevention and sustainable agroforestry management. At the same time, community groups and civil society should be involved early through participatory tools to ensure inclusive decision-making and local ownership.

Built-in scalable tools

The Resist model includes several built-in mechanisms to support replication and scaling up. Twin-region collaboration enables territories facing similar climate challenges to adopt tested digital tools and governance approaches, thereby avoiding duplication of efforts. Living labs, such as Herdade da Contenda, provide real-world environments to test nature-based solutions before wider deployment, helping reduce implementation risks. The project also demonstrates how public funding can be leveraged to scale up long-term adaptation action.

Funding pathways

The Resist project in Baixo Alentejo is primarily funded through the EU Mission on Adaptation to Climate Change. Local municipalities also complemented EU funding with additional public investment for infrastructure and implementation needs beyond the initial project scope. This combined funding approach demonstrates a scalable model for financing long-term climate resilience. In addition, the implementation of the AIGP is supported by complementary public investment, demonstrating how strategic planning, EU funding and national public investment can be combined to accelerate climate adaptation and strengthen long-term regional resilience. This blended financing approach provides a replicable model for supporting climate adaptation beyond the lifetime of individual projects.

Resist story • **Resistproject.eu** • **Mission adaptation projects**

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Cross-cutting

Technical expertise | Enhanced project capacity | Stakeholder engagement

Transforming a strategic plan into concrete action in the Košice region, Slovakia

Implementing nature-based solutions, promoting citizen engagement and advancing projects to respond to local climate risks

Climate hazards: Main themes:

Košice, Slovakia

Contact: Jan Dzurdzenik
Agency for the Support of Regional Development of Košice

Key figures

6 frameworks
refined

6 multistakeholder advisory boards
established

Implementation timeline

Since 2022

Solutions

As part of the EU Mission on Adaptation to Climate Change, the Košice region combines strategic planning, nature-based solutions and participatory governance to address climate risks.

1. **Framework refinement.**
Košice strengthened its climate adaptation strategy by transforming key regional documents into actionable roadmaps. Priorities now include water retention, ecosystem restoration and soil protection, with clearer indicators to track progress. This shift helps move from planning and awareness raising to implementation, thereby ensuring adaptation measures are measurable and targeted.

2. **Project guidance.**
Technical support provided by the EU Mission on Adaptation to Climate Change has helped the region improve project design and access European funding. This has enabled the preparation and implementation of initiatives under programmes such as LIFE (programme for the environment and climate action) and Interreg, including water and biodiversity projects in the Zemplín area and the Danube region. It has also supported urban demonstration projects like the greening of school spaces, focused on heat resilience and nature-based solutions.

3. **Participatory tools.**
The Košice region has prioritised inclusive, participatory approaches to ensure that adaptation efforts reflect community needs. Key initiatives include water and land restoration advisory boards, which act as multistakeholder platforms that bring together municipalities, universities, farmers, forest managers and volunteers, among others, to facilitate dialogue on local water management efforts. Public outreach has been conducted through events such as the youth competition called 'Water is over the gold', which engaged with schools and young people using expert guidance aimed at boosting participation and meaningful exchange.



Co-benefits

Economic
Improved access to European funding has enabled the development of adaptation projects and strengthened project pipelines. Pilots of nature-based solutions support more stable agricultural production and help safeguard key economic sectors. Urban greening initiatives can increase local attractiveness for tourism and investment, while also contributing to green job creation in areas such as water management, while reducing long-term costs linked to climate impacts.

Social
Adaptation efforts place communities at the centre of action. Water restoration advisory boards promote collaborative governance among municipalities, experts and citizens, strengthening trust and shared decision-making. Youth initiatives such as the 'Water is over the gold' competition raise awareness and encourage creative solutions, while urban greening projects related to school yards improve well-being and quality of life. Public events (e.g. in the newly created Envi Centre) further enhance local engagement and knowledge sharing.

Environmental
Nature-based solutions strengthen the Košice region's environmental resilience, with a focus on improving water quality and biodiversity. These actions support long-term ecosystem health, particularly in protected areas such as the Slovak Paradise National Park, and contribute to wider EU goals on biodiversity protection and carbon sequestration.

Replicability – *Who can use this approach and how*

Replicating the uptake of technical assistance and citizen engagement: models, tools and funding pathways

Scaling up experience beyond the Košice region

Best suited for

This approach is best suited for regions exposed to water-related climate risks that already have strategic adaptation plans but need support to move from planning to implementation. It is particularly relevant for local and regional authorities seeking to strengthen delivery capacity, improve access to funding and enhance stakeholder and citizen engagement.

Stakeholders' role

These initiatives rely on a multilevel governance approach. Regional authorities lead strategic planning and overall coordination, while municipalities implement local interventions such as urban greening and water retention measures. At the same time, stakeholder platforms bring together public bodies, experts, farmers and citizens to co-design and support implementation, ensuring shared ownership and stronger local anchoring.

Built-in scalable tools

The approach is highly transferable through its methods and structures. Project development practices can be adapted by other regions to improve the quality and readiness of proposals and strengthen access to funding. Participatory governance mechanisms, such as water and landscape advisory groups, can be replicated in different territorial contexts. Citizen engagement tools, including youth competitions and public initiatives, can also be easily adapted to raise awareness and mobilise local participation in other regions.

Funding pathways

Implementation is supported through a combination of EU funding programmes such as the EU Mission on Adaptation to Climate Change, LIFE and Interreg, complemented by national and regional resources. Local-level initiatives can also be financed through municipal budgets or targeted project funding, allowing gradual upscaling and replication across different governance levels.

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Cross-cutting

Cultural heritage | Stakeholder engagement | Historical infrastructure

Preserving cultural heritage for coastal climate adaptation in Piran, Slovenia

Strengthening coastal resilience through climate literacy, nature-based solutions and cultural heritage protection

Climate hazards: **Main themes:**

Piran, Slovenia

Contact: Cécil Meulenberg – cecil.meulenberg@zrs-kp.si

Key figures

1
digital map
Analysis of
many
possible ecosystem-based approaches

Implementation timeline

2021–2025

Solutions

Through the smart control of climate resilience in European coastal cities (SCORE) project, Piran serves as a coastal city living lab. It acts as a testing ground for innovative solutions addressing climate hazards such as heatwaves, coastal flooding, heavy precipitation, droughts and water scarcity, while safeguarding cultural heritage. The approach combines traditional infrastructure with ecosystem-based approaches, placing community engagement at the centre of coastal resilience.

1. **Stakeholder engagement and co-design.** Stakeholder engagement was central to the living lab approach, using workshops, surveys and knowledge-sharing activities to build a shared understanding of the climate hazards and the ecosystem-based adaptation options. A multicriteria analysis was conducted to assess and prioritise suitable measures, which included stakeholder voting. Key interventions such as tree planting, the renovation of historic water collectors and multipurpose green sites (urban green spaces) emerged as preferred solutions.
2. **Digital tools and citizen science.** An interactive citizen science application was developed to map key adaptation and cultural heritage assets across the city. Citizens contributed georeferenced data on green spaces, degraded areas, historic permeable pavements and traditional water-collection infrastructure such as underground wells and cisterns, strengthening the evidence base for planning.
3. **Ecosystem-based restoration of heritage systems.** Scientific analysis, including cost–benefit assessments, demonstrated the value of restoring historic rainwater collection systems and urban green spaces, particularly in tourism-sensitive areas. A digitised historic map from 1889 informed the identification of former water systems and permeable surfaces. This supported interventions such as the restoration of drystone walls, which stabilise terraced landscapes, improve soil moisture retention and reduce landslide risks, along with the reactivation of abandoned water collection systems that previously supplied the city.



Co-benefits

Economic

The project generates long-term cost savings by reducing damage to historic infrastructure and avoiding expensive grey infrastructure investments. Restored drystone walls help prevent landslides and associated climate damage, while reactivated rainwater harvesting systems reduce reliance on external water supplies during droughts. Enhanced cultural heritage and improved landscape quality also strengthen tourism appeal and support local economic activity.

Social

The living lab approach strengthens community cohesion and climate literacy through active citizen participation in workshops, voting processes and citizen science activities. By integrating local and traditional knowledge, the project empowers residents to shape adaptation strategies. Restoring traditional landscape practices, such as drystone wall construction, reinforces cultural identity and intergenerational knowledge transfer. Improved green spaces and water availability further enhance quality of life and community well-being.

Environmental

Ecosystem-based adaptation measures enhance biodiversity and strengthen the resilience of coastal ecosystems. Restored terraced landscapes and drystone walls reduce soil erosion and stabilise slopes, lowering landslide risks. Reactivated rainwater systems and potential permeable pavement restoration improve water retention, reduce run-off and support groundwater recharge, contributing to a more balanced and resilient local water cycle.

Replicability – *Who can use this approach and how*

A scalable model for strengthening coastal adaptation through cultural heritage and ecosystem-based solutions

How this validation approach can be adapted to different regions

Best suited for

This model is particularly suited to small and medium-sized coastal towns and water-scarce regions exposed to climate hazards such as drought, coastal flooding and sea-level rise. It is especially relevant for historic settlements with cultural heritage constraints, including traditional water management systems, terraced landscapes and other legacy infrastructures common in Mediterranean towns. These contexts often also benefit from strong intergenerational knowledge, which can be leveraged as part of adaptation planning and implementation.

Stakeholders' role

The model relies on a collaborative and interdisciplinary governance structure. Within the SCORE project, the Science and Research Centre Koper facilitated and moderated stakeholder engagement activities. Scientific partners led technical assessments and analytical work, while citizens, non-governmental organisations and local stakeholders contributed through participatory processes and knowledge exchange. This collaboration led to the creation of a dedicated working group, 'Valorisation and innovations of traditional architecture and landscape in Piran', ensuring continuity beyond the project's lifetime.

Built-in scalable tools

The approach is designed for stepwise, gradual and flexible upscaling. Modular interventions, such as the restoration of individual cisterns, typical Mediterranean gardens or drystone structures and walls, allow implementation to expand incrementally based on available funding and community priorities. Digital tools, including historic map digitisation and citizen science applications, support site identification, monitoring and replication in other locations. Participatory workshops ensure solutions are locally adapted, while the use of traditional materials and techniques reduces technical and financial barriers to upscaling.

Funding pathways

The model was implemented under the SCORE project, funded by the EU's Horizon 2020 programme. This EU support enabled the development and testing of ecosystem-based and heritage-based adaptation measures in coastal contexts. For long-term continuity and replication, the approach is designed to be embedded into municipal planning and maintenance frameworks, allowing gradual integration into local budgets.

> *'The challenge for a historic town like Piran and for all Slovenian coastal communities is to recognise and connect innovative adaptation solutions, such as historic rainwater collection systems, and dry-stone walls supporting terraced landscapes, with renewing the outdated historic sewer and drainage systems. Only in combination, these measures enable adaptation to warmer temperatures and floods, while preserving cultural heritage.'*
>
> **Dr Cécil Meulenberg**

Mission story • SCORE project • CORDIS

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Cross-cutting

Innovation tender for modelling | Outermost regions | Water stress

Strengthening resilience to water stress in the Canary Islands, Spain

Using participatory processes and open tenders to o co-develop water-resilience solutions in an outermost region

Climate hazards:

Main themes:

Canary Islands, Spain

Contacts: Panepistimio Thessalias (Arsinoe project coordinator)
University of La Laguna (ULL) (Canary Islands case study leader)

Key figures
Innovation tender for up to
EUR 50 000

Implementation timeline
2021–2025
Arsinoe project timeline

Budget
EUR 50 000
data platform development
+ EUR 50 000
data platform implementation

Solutions

The Arsinoe project developed innovative approaches to strengthen climate resilience across the EU. The project's fifth case study was in the Canary Islands, Spain, an outermost region of the EU. The region faces significant water scarcity, with increasingly vulnerable aquifers due to recent volcanic eruptions. Agriculture, an economically important sector for the region, is the largest water-consuming sector and relies on efficient water management. Simultaneously, the Canary Islands are committed to sustainable growth, as seen in their smart specialisation strategy. Through this case study, the project aims to facilitate the region's ecological transition and address the aquifers' vulnerabilities by improving the primary production sectors with solutions including the following.

1. **Living labs.**
   Three living labs participatory workshops were organised, focused on the impacts of rising temperatures on the region's agriculture and water resources. The aim of the workshops was to bring together different stakeholders – such as public administration, water actors, farmers and landowners, and digital tool developers – to identify barriers together and co-design adaptation strategies.
2. **Governance analysis.**
   A governance analysis was carried out in Tenerife, El Hierro and La Palma. The analysis focused on regional water policies.
3. **Open tender for innovative digital tool.**
   An innovation tender of up to EUR 50 000 was launched during the case study, with 10 applicants. The tender was awarded to the Foundation for Climate Research, which is responsible for the development of the SICMA Canarias tool. This tool deals with the collection and exchange of environmental, agronomic, economic and social data from the region, focusing on adaptation for agriculture. The tool, co-designed with stakeholders, provides a user-friendly platform that integrates different climate data layers, indicators and variables. Future projections of temperature and precipitation are also integrated, at a 100 metre × 100 metre local resolution, based on the sixth Intergovernmental Panel on Climate Change report.
4. **Research on groundwater and sea-level rise.**
   Research was carried out on regional groundwater and sea-level rise.

Co-benefits

Economic

This case study in the Canary Islands supports regional economic resilience by improving the capacity of important economic sectors to adapt to climate change, with a particular emphasis on agriculture. The SICMA Canarias tool provides climate information, indicators and future projections in accessible formats. This can support improved agricultural decision-making and adaptation interventions, such as crop rotation and relocation of crop areas according to present and future changing climatic conditions.

Social

The case study provided social benefits with its focus on strengthening collaboration between different actors in society impacted by the effects of climate change. Through the three living labs workshops, stakeholders such as public administrators and farmers were brought together to jointly identify barriers and co-design future adaptation options. This process supported greater awareness of climate risks, both current and future, and improved communication between stakeholders by encouraging shared ownership of adaptation pathways.

Environmental

The case study contributes to environmental resilience by supporting the improved understanding and management of climate impacts on water resources through different economic sectors. The SICMA Canarias tool integrates high-resolution climate projections, helping stakeholders assess future climate risks and design adaptation measures that can help protect natural areas. Additionally, research on groundwater and sea-level rise improved knowledge of vulnerabilities affecting island water resources, which in turn support fragile aquatic ecosystems. These actions support the more sustainable management of natural resources and help prevent further ecosystem degradation.

Replicability – *Who can use this approach and how*

Scaling up climate resilience for water-scarce regions

Using this approach to strengthen resilience in similar regions

Best suited for

This model is best suited for outermost regions – mainly islands – that are facing climate-related pressures on water resources, and hence water-dependent economic activities such as agriculture. This model is especially relevant where local-level climate information, stakeholder collaboration and improved resource management approaches are needed to support adaptation decision-making. The combination of living labs participatory workshops, governance analysis and the SICMA Canarias climate information platform provide an approach that can be adapted to different regions facing similar scenarios.

Stakeholders' role

Stakeholders play a central role in the replicability of the Canary Islands case study mode. Solutions were co-designed through participatory processes. The living labs workshops brought together public administrations, water-sector actors, farmers and digital tool owners to identify barriers and develop adaptation strategies. Actors external to the project also contributed through the open tender for innovation. This participatory model allows the approach to be adapted to different regional contexts by incorporating local knowledge, sectoral priorities and local governance structures.

Built-in scalable tools

The SICMA Canarias tool integrates multiple climate data layers, indicators and derived variables, including high-resolution future climate projections at the granular local level. Its structure enables adaptation to other regional contexts by combining climate information with locally relevant environmental, agricultural, economic and social data. The use of downscaled climate projections and a user-friendly digital platform provides a transferable method for supporting climate adaptation planning in other regions. The participatory approach taken with the living labs workshops can also be replicated in other regions to collect valuable insights from different actors.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Arsinoe project, as part of the EU Mission on Adaptation to Climate Change.

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Cross-cutting

Early warning systems | Real-time inputs | Citizen participation

Enhancing emergency preparedness in Catalonia, Spain

Strengthening climate-related disaster preparedness through digital tools and a citizen participatory toolkit

Climate hazards:

Main themes:

Catalonia, Spain

Contact: Shinju Park (regional coordinator and SSWs solution, UPC) – shinju.park@upc.edu; Xavi Llort (EWS solution, Hyds) – xavi.llort@hyds.es; Núria Gasulla Fernández (Citizen Participatory Toolkit solution, DGCP) – ngasulla@gencat.cat; Maria Cifre Sabater (Citizen Participatory Toolkit solution, UOC) – mcifresa@uoc.edu

Key figures

1 500
workshop participants

3 solutions
to be replicated in

20+ municipalities

Implementation timeline

2023–2027
Resist project timeline

Budget

EUR 5 000–50 000
to deploy Argos

EUR 25 000–50 000
for the participatory process

Solutions

The Resist (regions for climate change resilience through innovation, science and technology) project, funded through Horizon Europe as part of the EU Mission on Adaptation to Climate Change, aims to strengthen climate resilience and accelerate adaptation in vulnerable European regions by implementing large-scale demonstrations of innovative adaptation solutions and transferring these solutions to partner regions. Catalonia is one of the four leading demonstration regions in the project. Here, adaptation solutions focusing on emergency management during climate-related disasters are being tested in three municipalities: Terrassa, Blanes and Alcanar.

1. **Multi-hazard early warning system (Argos).** A web-based early warning system referred to as 'Argos' was developed to anticipate and manage risks associated with extreme weather. New systems were implemented at the municipal level to collect local data and enhance the emergency-management process. Argos supports various aspects of this process, including proactive risk management, rapid decision-making, optimised resource coordination and municipal customisation. It integrates real-time inputs from local sensors and risk maps, allowing for timely forecasts. Its effectiveness was demonstrated during the intense storms that affected the city of Terrassa on 2 August 2024. Argos issued early warnings for several critical locations, particularly at fords crossing the Palau Stream, and integrated data from emergency calls to the 112 service, providing municipal authorities with a more comprehensive picture of the event and supporting more effective emergency management. This example illustrates how Argos strengthens local emergency response capacities and highlights the growing importance of integrated early warning systems in reducing the impacts of increasingly frequent climate-related extreme weather events.
2. **Impact-based site-specific warnings (SSWs).** The scope of SSWs in the area was expanded to trigger self-protection protocols tailored to a variety of hazards and locations. These warnings target high-priority civil protection sites, such as schools and flood-prone roundabouts. The system alerts municipal technicians and the public of imminent situations, such as flash floods, allowing time for preparatory action. Like Argos, this system also integrates real-time inputs from local sensors and risk maps. As part of this framework, the Blanes civil protection service has reviewed its alert thresholds, incorporating local expert knowledge of critical points, particularly along the Tordera River, to improve the relevance and reliability of the warnings.
3. **Citizen Participatory Toolkit.** The toolkit supports inclusive and participatory climate adaptation by providing practical methods for engaging citizens, community organisations and public authorities to take part in climate adaptation planning. It pays particular attention to vulnerable groups and perspectives that are often under-represented in decision-making. By combining survey questionnaires, ethnographic fieldwork, interviews, citizen dialogues and other participatory methods, the toolkit integrates local knowledge and everyday experiences into decision-making processes. As part of the Citizen Participatory Toolkit, a series of citizen dialogues on extreme heat risk were carried out in Terrassa. The dialogues have already informed several concrete actions led by Terrassa City Council and the civil protection service. A new risk communication channel has been implemented through 13 digital screens in libraries and public transport stations, broadcasting preventive messages and emergency alerts. The civil protection service has also started implementing the extraordinary opening of climate shelters during extreme heat events. This approach was recently piloted by opening three civic centres during a heatwave weekend, providing shelter and support to approximately 80 to 90 people. Internal communication procedures with neighbourhood districts and community organisations are also being strengthened.

Co-benefits

Economic

Argos and the SSWs deployed as part of the Catalonia pilot have the potential to generate significant economic benefits by reducing disaster-related losses through enhanced community preparedness and more effective risk management. Earlier and more accurate extreme weather warnings enable public authorities, businesses and citizens to implement adaptive measures before hazardous events occur. This can translate into substantial indirect cost savings by reducing infrastructure damage, emergency response expenditure, insurance claims, service interruptions and transport disruptions.

Social

This demonstration places a strong emphasis on citizen empowerment. Its solutions strengthen community resilience by improving public safety, increasing risk awareness and encouraging active citizen participation in adaptation.
The Citizen Participatory Toolkit encourages dialogue between citizens and authorities on

adaptation themes, while also ensuring that the experiences, needs and capacities of different community groups – particularly those most vulnerable – are better reflected in adaptation planning and risk communication. Combined with inclusive risk communication and early warning systems, these measures can enhance trust between citizens and public authorities, resulting in increased support for adaptation decisions made on their behalf. In addition, improving emergency preparedness enhances citizen well-being.

Environmental

The solutions deployed in the Catalonia pilot may contribute to environmental resilience by supporting more proactive management of climate-related risks and, in some cases, reducing their impacts on ecosystems. Enhanced monitoring capabilities and early warning systems improve the detection of environmental hazards, enabling faster and more effective response measures. For instance, the integration of a thermal camera in Terrassa for the automatic detection of forest fires has strengthened local wildfire monitoring. Following an extensive testing period, the system is now fully operational and automatically sends fire and smoke detection alerts via email to the civil protection service, facilitating a rapid response to potential incidents. Earlier intervention may help limit the extent of wildfire damage, thereby protecting surrounding natural areas and biodiversity. In addition, the pilot improves communication with residents regarding wildfire risks and incidents, increasing public awareness, encouraging timely protective action and strengthening overall community resilience.

Replicability – *Who can use this approach and how*

Scaling up emergency preparedness across Europe

Providing valuable information on climate-related disasters before they happen

Best suited for

These solutions are best suited for regions that are exposed to climate-related emergencies, such as floods, wildfires and other severe weather events. They are particularly relevant for those seeking to strengthen their risk preparedness, through digital tools such as early warning systems, in order to protect citizens and the critical infrastructure on which the communities depend.

Stakeholders' role

The solutions were developed through interdisciplinary collaboration based on a quintuple helix approach. This approach brings together six key partners with different areas of expertise: the Directorate-General for Civil Protection of the Ministry of Home Affairs and Public Safety (emergency management and citizen engagement), the Universitat Politècnica de Catalunya (technological development), the Universitat Oberta de Catalunya (social inclusivity), Hyds (technological development) and the municipalities of Terrassa and Blanes (demonstration). Citizens also acted as key stakeholders in this pilot project, contributing valuable information to ensure all actions remained contextually grounded.

Built-in scalable tools

The solutions were designed with scalability in mind. The overall aim is to replicate the three solutions deployed in over 20 municipalities in the Catalonia region. Aside from this, scalability is further enabled through a structured transfer procedure, expanding the model to Catalonia's two twinning regions: Baixo Alentejo and Puglia. The early warning system and the Citizen Participatory Toolkit will be transferred to the Baixo Alentejo municipality. In Puglia, on the other hand, all three solutions will be implemented to enhance climate adaptation policymaking within the tourism sector.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Resist project, as part of the EU Mission on Adaptation to Climate Change.

Resist • Pilot • Deliverable 1.1 • Deliverable 3.19

This solution is part of Mission Solutions Catalogue

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Cross-cutting

Immersive technologies | Digital twinning | Stakeholder engagement

Using advanced technologies to support better climate decision-making in Blekinge, Sweden

Extended reality, digital twins and gamification for climate resilience

Climate hazards:

Main themes:

Blekinge, Sweden

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SINTEF AS, Norway
Coordinator of Resist project

Key figures

100+
students participating

30+
workshops

Implementation timeline

2023–2027

Solutions

The Resist (regions for climate change resilience through innovation, science and technology) project, supported by the EU Mission on Adaptation to Climate Change, brings together digital innovation, citizen engagement and real-world experimentation to strengthen climate resilience in Blekinge by empowering stakeholders. It positions the region as a living test bed where adaptation solutions are designed, tested and refined through collaboration between European regions, notably through twinning with Central Denmark.

1. **Digital twinning.**
Blekinge acts as a twinning region, enabling it to adapt and transfer solutions developed elsewhere in the EU, in particular from Central Denmark. This supports rapid learning, cross-regional replication and evidence-based adaptation grounded in real territorial conditions.

2. **Immersive technologies.**
The project uses extended reality (XR) and virtual production tools to make climate risks tangible and enable informed action. These environments allow users to immerse themselves in simulated future climate scenarios and experience adaptation options before implementation, supporting more robust planning that integrates environmental and socioeconomic dimensions. Gamification complements this approach by turning climate risk exploration into an interactive experience. It enables citizens to directly engage with adaptation choices and encourages behavioural change through experiential learning rather than abstract information.

3. **Engagement.**
Resist is built on a quintuple helix model, bringing together public authorities, academia, industry, citizens and non-governmental organisations as co-creators of solutions. This ensures adaptation is developed collaboratively across society. Experimental policy labs provide structured spaces where citizens directly engage with spatial planning and climate adaptation challenges. This is reinforced by strong educational involvement, with over 100 students participating and more than 20 applied projects developed.
In parallel, more than 30 workshops, interviews and collaborative sessions with stakeholders and institutions have strengthened shared ownership and anchored the project in local needs.



Co-benefits

Economic
Resist reduces long-term adaptation costs by enabling pre-implementation testing of solutions through digital twins and XR tools, avoiding expensive trial-and-error approaches. It also strengthens human capital by equipping students and participants with practical climate adaptation skills, contributing to new competencies, employability and the emergence of innovation-driven economic activities in the resilience sector.

Social
The project transforms citizens from observers into active participants in resilience building. Through immersive tools, gamified experiences and participatory workshops, it makes climate risks understandable and enables informed action. The quintuple helix model ensures inclusive governance, strengthening trust between institutions and society while fostering shared ownership of adaptation pathways. By reframing climate change from abstract risk to collective problem-solving, it helps shift perceptions from anxiety to agency.

Environmental
By embedding digital simulation into planning, Resist supports better-informed decisions that protect ecosystems and enhance biodiversity. XR tools help visualise the environmental impacts of different interventions, guiding nature-positive choices such as greening and ecosystem restoration. Policy labs further integrate adaptation into spatial planning processes, while immersive engagement fosters long-term behavioural shifts that reduce pressure on natural systems.

Replicability – *Who can use this approach and how*

A scalable model for supporting decision-making through digital innovation

From digital tools to transferable climate decision-making systems across regions

Best suited for

This approach is particularly suited to regions where public engagement with climate hazards remains limited and where awareness of local climate risks is still developing. It is also effective in contexts where there is a basic level of digital readiness, as this facilitates the uptake of tools such as simulations, digital twins and interactive platforms. Replicability is further strengthened through participation in EU funding-wide initiatives such as Resist, which provide technical assistance, shared methodologies and tested digital solutions. This enables regions with limited internal capacity to adopt and adapt advanced tools without needing to build them from scratch.

Stakeholders' role

The model is built on a quintuple helix framework that integrates public authorities, academia, industry, citizens and civil society into a shared co-creation process. In the case of Resist, implementation is coordinated through local partners, including Region Blekinge Resist and Blekinge Institute of Technology, which connect regional delivery with the wider European project structure. Citizens and students are not passive users but active contributors, particularly through engagement activities, experimentation and applied learning. This distributed model ensures that knowledge flows in both directions, from institutions to society and back into planning and innovation processes.

Built-in scalable tools

The digital backbone of the model makes it inherently scalable. Digital twinning and immersive technologies function as adaptable templates that can be reconfigured for different regions, risks and policy priorities. regions can integrate their own data and contextual information while maintaining a shared methodological structure, which significantly lowers replication costs and complexity. Equally important is the scalability of the engagement model. Policy labs, workshops and multistakeholder collaboration formats can be reproduced across governance systems with limited adaptation, making it possible to scale up not only the technology but also the participatory process that drives it. This combination of technical and social scalability is a key enabler of replication.

Funding pathways

The model was initially financed through the RESIST project under the EU Mission on Adaptation to Climate Change, providing a strong foundation for experimentation, cross-regional learning and early-stage deployment of innovative digital tools. Its long-term replicability is supported by a flexible funding approach. Once validated, the tools and approaches can be integrated into regional operational budgets, climate adaptation strategies and innovation programmes. The demonstrable benefits of digital twinning, immersive planning and citizen engagement also make the model attractive for a broader mix of funding sources, including European programmes, national resilience strategies and potential private-sector partnerships linked to digital infrastructure, skills development and climate risk management.

Mission story • CORDIS • Project • Catalogue

This solution is part of Mission Solutions Catalogue

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Cross-cutting

Indigenous knowledge | Nature-based economies | Citizen science

Helping Arctic communities adapt to a rapidly changing climate in Lapland, Finland

Integrating local knowledge and digital tools to develop adaptation plans that protect Indigenous communities

Climate hazards:

Main themes:

Lapland, Finland

Contact: MountResilience project coordinator, Università degli Studi di Milano, Italy
Lotta Eriksson, project manager, Regional Council of Lapland

Key figures

1
digital tool

2
types of adaptation planning

Implementation timeline

5 years
The MountResilience project spans from 2023 to 2028

Solutions

MountResilience is a Horizon Europe project funded through the EU Mission on Adaptation to Climate Change, aiming at helping mountain communities build resilience to the impacts of climate change. The project works across several alpine and mountainous regions to develop, test and scale practical adaptation and nature-based solutions tailored to local needs. It also aims to encourage behavioural change among citizens so they can better respond to climate challenges specific to mountain environments. In the Finnish Lapland region, climate hazards, including rising temperatures and reduced snow cover, are already affecting the vulnerable Arctic environment, causing it to warm faster than the global average. The solutions put forward in this project case study aim to help local and Indigenous communities adapt to these hazards.

1. **Public Participation Geographic Information System (PPGIS).**
The PPGIS is an online tool that is in development. This tool leverages citizen science and collects observations from different stakeholder groups to better track climate impacts, including local communities, Sami people, reindeer herders and tourism operators.

2. **Regional and company-specific adaptation plan development.**
Regional adaptation plans will be developed based on risk mapping and analysis. The plans will promote long-term sustainability, cultural preservation and economic resilience. Aspects such as sustainable reindeer herding and the associated importance of winter tourism will be integrated. Information from surveys and workshops bringing together local actors, such as reindeer herders, researchers, municipalities and tourism companies, will also be collected and used in the design of these plans. Company-specific adaptation plans will also be developed, reinforcing the ability of entrepreneurs to identify ways in which their own businesses, which are vulnerable to climate impacts, can be strengthened.

3. **Coaching opportunities.**
Opportunities for knowledge-sharing and coaching sessions will be organised to help local communities transition to more sustainable and adaptable lifestyles.



Co-benefits

Economic

This case study helps strengthen the resilience of Lapland's nature-based economy by helping municipalities, tourism businesses and reindeer herders anticipate and adapt to climate risks. This includes livelihoods, such as reindeer herding and tourism. These activities are particularly important for the Sami community, Europe's only recognised Indigenous people, who populate the municipalities in northern Finland where the pilot is taking place. A key aspect of this is the possibility of diversifying tourist activities, such as hiking, wildlife watching and cultural tours, which could reduce dependence on highly seasonal activities such as skiing. In this way, climate-related economic losses are reduced, encouraging more sustainable, year-round economic opportunities. Other examples that are promoted include shifts to more sustainable reindeer herding techniques. Company-specific adaptation plans, regional adaptation planning and tailored coaching activities can also support business continuity by improving preparedness and identifying ways forward.

Social

The solutions in Lapland promote inclusive and participatory climate adaptation by bringing together different actors, including municipalities, researchers, tourism operators, reindeer herders and local communities. Special attention is paid to the cultural dimensions of nature-based livelihoods, as through them the effects of climate change also threaten the viability of Sami culture. Important traditional knowledge of the Sami people will be included in adaptation planning, along with input from other stakeholders to facilitate collaboration. Through workshops, surveys and the PPGIS, this data can be used to support sustainable land use and ensure that adaptation measures reflect local needs and cultural values.

Environmental

The project improves understanding of the impacts of climate change on Arctic ecosystems, in Lapland specifically, by combining scientific input with citizen-generated observations through the PPGIS platform. The resulting knowledge informs adaptation planning and supports the long-term protection of Arctic landscapes and biodiversity.

Replicability – *Who can use this approach and how*

Replicating the Lapland approach

How other mountainous regions can adopt digital tools to collect information and co-develop adaptation plans

Best suited for

This model is best suited for mountain and Arctic regions facing increasing climate risks that affect ecosystems, local livelihoods and cultural heritage, particularly rising temperatures, reduced snow cover and shorter winters. It is particularly relevant for regions where adaptation requires balancing with livelihoods such as tourism, forestry, agriculture and reindeer herding. The approach is particularly relevant where Indigenous and local knowledge can strengthen climate decision-making.

Stakeholders' role

The case study is built on strong stakeholder participation throughout the development and implementation of the various solutions. Municipalities, regional authorities, Sami representatives, reindeer herders, tourism operators, researchers, businesses and local communities contribute climate observations and local knowledge through the PPGIS, participate in workshops and surveys and help co-design adaptation measures and the regional adaptation plan. This collaborative governance approach ensures that adaptation actions are locally relevant, socially acceptable and supported by those who will implement them.

Built-in scalable tools

The case study incorporates several tools that can be replicated in other mountain regions. The PPGIS platform provides a transferable method for integrating citizen observations and local knowledge into climate adaptation planning. The methodology for developing a regional adaptation plan, including climate risk mapping, stakeholder engagement and co-creation workshops, can be adapted to different regional contexts. In addition, the coaching and knowledge-sharing activities provide a practical approach for building local adaptation capacity and supporting the uptake of climate resilience measures across different mountain communities.

Funding pathways

The MountResilience project is funded under Horizon Europe grant agreement number 101112876.

MountResilience.eu • CaseStudy • D2.1 • D1.3 • CORDIS

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Cross-cutting

Fund redirection | Nudging | Outermost regions

Strengthening the resilience of the tourism and agricultural sectors in Guadeloupe, France

Using behavioural and financing measures to increase the resilience of an outermost region of the EU

Climate hazards:

Main themes:

Guadeloupe archipelago, France

Contact: Antwerp University
TransformAr coordinator

Key figures

EUR 1 240 000
mobilised for local adaptation projects

6
projects launched after first call

Implementation timeline

5 years
The project spans from 2021 to 2025

Solutions

The TransformAr project aimed to develop, test and demonstrate innovative products, services and pathways for adaptation to accelerate the transformation of EU regions that are vulnerable to climate hazards. Thanks to its diverse partners, it showcased the solutions being developed in six demonstrator regions. One of those demonstrators was in the Guadeloupe archipelago, an outermost region vulnerable to droughts, floods and other hazards.

1. **Nudging solution.**
This digital tool combines technology with behavioural nudging techniques to promote water conservation among hotel guests, who make up a significant portion of the population during the touristic season. Digital shower sensors were installed in participating hotels in the archipelago, capable of measuring water usage and shower duration. This real-time data is then uploaded to Aquardio Hub, which is a central platform for analysis. This analysis was paired with nudging communications to encourage reduced water usage.

2. **Guadeloupe Adaptation Fund (FLAG).**
FLAG is an innovative financing mechanism that pools public and private local budget lines to support small-scale adaptation projects. The target of this fund is the agriculture and tourism sector. The fund aims to unlock ad redirect budgets for customised adaptation solutions and bridging the gap between private needs and interests in climate adaptation. The fund was established in three main phases. The first was a feasibility study of the proposed financial mechanism, using data from desk research, interviews, and workshops with stakeholder groups from the tourism and agriculture sectors. The second phase was the design of FLAG's decision-making and governance structure, focusing on aspects such as the legal and administrative requirements for pooling budget lines and the criteria for awarding projects. The third and final phase was the launch of a call for proposals, followed by the selection of the first batch of local adaptation projects. Project proposals had to align with adaptation categories, including governance, investment, and research and innovation. Six projects were selected for a total budget of EUR 1.24 million. FLAG facilitated the mobilisation of over EUR 1 million of this funding, with EUR 900 000 coming from public grants and EUR 100 000 from private-sector actors.

Co-benefits

Economic

The solutions implemented in Guadeloupe generate important economic co-benefits by improving the efficiency of water use and increasing the mobilisation of funding for adaptation projects. The nudging solution helps hotels reduce water consumption, effectively reducing operational costs and easing pressure on local water supplies during peak tourist seasons. FLAG provides the most significant economic benefits. In the French outermost regions, including Guadeloupe, climate change adaptation actions are underfunded. Several challenges exist in accessing EU funds due to various factors, including complex administrative processes and a lack of communication about available opportunities. By mobilising and directing public and private finance to support local adaptation projects, this helps fund action that would previously have not been possible. The projects themselves, relating to agricultural and tourism resilience, also contribute to protecting local livelihoods of communities that depend on these sectors economically.

Social

The solutions strengthen community resilience by promoting behavioural change and stakeholder collaboration. The nudging solution raises awareness among hotel guests about responsible water use, encouraging more sustainable habits that can ultimately continue beyond their stay on the island. FLAG brings together different actors, including tourism and agricultural operators, public institutions and banks, to jointly identify and finance adaptation priorities. This improves local participation in decision-making, supporting vulnerable communities who depend on these vulnerable sectors.

Environmental

The solutions implemented contribute to the sustainable management of the islands' natural resources, both directly and indirectly. The nudging solution works to reduce freshwater consumption in hotels, helping to conserve limited water resources in an already water-scarce region, thus helping to strengthen the resilience of fragile groundwater ecosystems. FLAG, on the other hand, supports projects that themselves work on resource management, such as the Resafor project that promotes agroforestry for vanilla production.

Replicability – *Who can use this approach and how*

Scaling up the resilience of outermost regions

Strengthening the tourism and agricultural sector

Best suited for

This model is best suited for outermost regions of the EU, which are considered hotspots for multiple climate risks such as hurricanes, sea-level rise, forest fires, volcanic activity, droughts and floods. It is particularly well suited for those regions that are very economically dependent on tourism and agriculture. The nudging tool works well in areas where hotel management is open to taking steps to improve water efficiency through a behavioural approach. The FLAG portion of the model is relevant for those regions that experience barriers to accessing international funding, particularly funding related to adaptation actions. In this way, regions can mobilise and redirect existing funds to meet adaptation needs in vulnerable areas by using small-scale, locally led actions.

Stakeholders' role

The model relies on close collaboration between many different stakeholders. Hotels participate by installing water monitoring devices and engaging guests in water-saving initiatives, while technology providers manage data collection and its analysis. FLAG development and implementation involve many additional stakeholder groups, such as public authorities, financial institutions and private-sector organisations.

Built-in scalable tools

Both solutions developed through this model incorporate features that support replication and scaling. The low-cost nudging tool combines commercially available water sensors with a central digital platform that can be adapted for different accommodation types and locations. FLAG offers a transferable governance and financing framework, and lessons learnt and approaches from this can be reapplied to other regions facing similar situations.

Funding pathways

The pilot case was developed through the Horizon Europe-funded TransformAr project, as part of the EU Mission on Adaptation to Climate Change.

Transform.Ar • **CaseStudy** • **ClimateAdapt** • **CORDIS**

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Cross-cutting

Climate stations | Application | Innovation hub

Strengthening climate resilience using smart technology and citizen engagement in Egaleo, Greece

Using a combination of one technological add solution before and three citizens' engagement measures to increase resilience

Climate hazards: **Main themes:**

Egaleo, Greece

Contact: Antwerp University
TransformAr coordinator

Key figures

21
smart climate stations installed

Climate-awareness modules for students aged
13–15

Implementation timeline

5 years
The project spans from 2021 to 2025

Solutions

The TransformAr project aimed to develop, test and demonstrate innovative products, services and pathways for adaptation that accelerate transformation in EU regions that are vulnerable to climate hazards. It brought together diverse partners and showcased the solutions being developed in six demonstrator regions. One of them was Egaleo, a city exposed to increasing temperatures, precipitation, storms and floods. The solutions implemented include the following.

1. **Smart climate stations (SCSd).**
Twenty-one SCSd were installed around the city. The purpose of these devices is to gather real-time data on the location's microclimate. The data collected included temperature, relevant humidity, atmospheric pressure, carbon dioxide and particulate matter concentrations, wind speeds and rainfall. This data was linked to municipal systems and participatory platforms, allowing for timely interventions depending on actual conditions.

2. **Climate innovation hub.**
An underutilised facility was transformed into a dynamic space for communities to gather for climate education and awareness raising. It tackles climate misinformation and limited engagement through permanent exhibitions, citizen-led events and more.

3. **Citizen app.**
An application was developed to gather information and distribute it to Egaleo's citizens. Data about residents' climate awareness is collected using a detailed questionnaire. Simultaneously, the app can also be used to provide notifications and information on climate-related events occurring in the city, while also disseminating the solutions developed by this demonstrator.

4. **Citizen engagement.**
Educational initiatives were organised to engage students, teachers, parents and other citizens in efforts to promote climate awareness and scientific literacy. Student programmes on climate science, hazards and potential adaptation pathways were integrated into school classes. Community initiatives were organised, such as an open green day in which young people were encouraged to analyse real-world environmental data, along with awareness-raising presentations. Climate data was also used for analysis in a hackathon. Lastly, living labs workshops were organised in schools for the co-design of community adaptation measures.

Co-benefits

Economic
The solutions implemented in Egaleo strengthen its capacity to make evidence-based decisions. This contributes to reducing costs associated with climate hazards, such as floods and heatwaves. Real-time environmental data from the smart climate stations supports more informed and targeted interventions. Additionally, the climate innovation hub promotes green innovation and climate-friendly entrepreneurship by providing a space where citizens, researchers, small and medium-sized enterprises and local authorities can collaborate, supporting the development of new ideas and skills for the local green economy.

Social
The demonstrator has significantly strengthened citizen engagement and climate awareness. Through initiatives such as the climate innovation hub, the citizen app, living labs workshops and hackathons, residents have gained access to climate information and opportunities to actively participate in designing local adaptation pathways. These activities improve climate literacy, counter misinformation and encourage collaboration between stakeholder groups. This ultimately strengthens community cohesion and empowerment. Additionally, by allowing for better monitoring of the local microclimate, SCSs allow public authorities to better protect citizens through more targeted implementation of measures. Lastly, the citizen app also safeguards resident safety by transmitting notifications of any climate hazards.

Environmental
By providing continuous information on local climate conditions, SCSs help the municipality better understand the climate risks facing by Egaleo, and how to respond to them effectively. This can equip the city to better respond to emergencies, which can prevent excess damage to natural areas, such as flooding and extreme heat.

Replicability – *Who can use this approach and how*

Scaling up the resilience of Mediterranean towns

Using engagement and smart systems as a tool for resilience

Best suited for

This model is best suited for municipalities and regions facing climate risks such as extreme heat, droughts and heavy precipitation. This integrated approach can be replicated by local authorities seeking to combine climate monitoring, digital communication, citizen participation and climate education within a single, well-rounded approach. It is especially relevant for medium-sized cities that want to strengthen climate resilience through data-driven governance and active community involvement.

Stakeholders' role

This model requires effective collaboration between different actors, including municipalities, research organisations, schools, citizens and technology providers. Municipal authorities coordinate implementation and integrate climate data into decision-making processes, while research institutions support the deployment and analysis of monitoring systems. Schools play a key role in delivering climate education and hosting living labs workshops, while citizens contribute through the mobile application, participatory events and co-design activities. Local businesses and civil-society organisations can further strengthen innovation, awareness raising and the long-term sustainability of the solutions.

Built-in scalable tools

The model uses many tools designed for replication and scaling. These include SCSs, which can be expanded to monitor additional locations. The citizen application can be adapted to different municipalities. The climate innovation hub can be used as a flexible model for combining climate data, education and community engagement in a single space. Together with open participatory approaches such as living labs workshops, hackathons and awareness campaigns, these solutions provide a modular framework that can be adapted to different local contexts. The TransformAr project also developed a replicability assessment tool to help regions evaluate and plan the transfer of adaptation solutions to their own circumstances.

Funding pathways

The pilot case was developed through the Horizon Europe-funded TransformAr project, as part of the EU Mission on Adaptation to Climate Change.

Transform.Ar • CaseStudy • CORDIS • MissionStory D5.1 • D3.5 • Replication

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Cross-cutting

Modelling | Digital twins | Arctic

Better preparing for Arctic climate hazards in Troms County, Norway

Using a combination of digital tools and stakeholder outreach to better inform adaptation decisions to cope with landslides, avalanches and other natural disasters

Climate hazards:

Main themes:

Troms county, Norway

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Key figures

1
digital twin

Engagement of
4
main stakeholder groups

Implementation timeline

5 years
The project spans from 2021 to 2025

Solutions

The Impetus project aimed to accelerate the EU's climate-neutrality and adaptation efforts by developing practical, scalable actions that strengthen resilience across communities, sectors and regions. It worked to empower stakeholders with knowledge, data, and innovation capacity to co-design, implement, and sustain effective climate resilience solutions across seven EU biogeographical regions. One of its five demonstration sites tackles the Arctic biogeographical region, using Troms county as the target area. Rising temperatures and heavy precipitation are increasing the region's exposure to landslides, avalanches, rockfalls, and resulting fjord tsunamis. The solutions developed include the following.

1. **Digital twin of Tromsø city.**
The digital twin provides a detailed 3D visualisation of the city. This tool can be used to understand how climate hazards such as flooding and storm surges impact important urban infrastructure, such as residential areas and hospitals. It also allows users to evaluate how city area regulation plans are affected by different degrees of storm surge scenarios. In this way, it facilitates informed discussions for data-backed decision-making.

2. **Marine spatial planning framework.**
This framework is a map-based tool based on ArcGIS software. It highlights climate risks within the coastal areas of the region, allowing the user to visualise and evaluate how hazards such as avalanches, storm surges and flooding may interact with regulation and coastal plans in place, as well as exposed infrastructure. Users are also able to incorporate their own datasets through the ArcGIS software to explore impacts of more specific hazards in different areas of the region.

3. **Avalanche and slush flow assessment.**
Assessments were carried out to evaluate future risks in terms of avalanche and slush pathways using simulations and machine-learning models. These assessments help to evaluate how climate change is expected to alter risks related to such hazards within the region in the near future and translate this information into action for planning and early warning. The assessment uses climate projections and terrain and hazard data, which are paired together to identify areas most at risk from these hazards, along with the development of automatic early warning systems that take such data into account using statistical models.

4. **Guidelines for citizen juries and virtual reality (VR).**
Guidelines were developed to provide a methodology for the design and facilitation of participatory exercises in the form of structured citizen jury processes. The aim of this approach is to ensure that stakeholder perspectives are systematically incorporated into climate adaptation decisions. Using VR visualisations, such as the Tromsø city digital twin, participants can experience realistic representations of future hazard scenarios, informing their input into relevant decisions.



Co-benefits

Economic

The solutions developed in the Arctic case study generate important economic co-benefits by supporting more informed investment and planning decisions that reduce future climate-hazard-related economic losses. The digital twin, marine spatial planning framework and hazard assessments may help actors such as local authorities identify areas at risk from such hazards. In this way, adaptation interventions can be implemented to reduce damages. In addition, the approval of new infrastructure and developments can be discussed based on updated risk information, helping to reduce costly damages and disruption of critical services. Improved early warning systems for avalanches and rockfalls, among other hazards, may also help reduce recovery costs, since communities will be better prepared and factors such as evacuations can be implemented in a timely manner. Together, these solutions contribute to a more holistic understanding of future risks, improving efficient public spending, more resilient infrastructure investment and lower long-term costs associated with climate adaptation and disaster recovery.

Social

The solutions strengthen community resilience by directly contributing to improving the safety of local communities. More accurate risk assessments and early warning systems help protect lives by enabling authorities and emergency services to better prepare for hazards like avalanches and slush flows, while ensuring that citizens are out of harm's way in time. On the other hand, citizen jury activities and VR experiences create meaningful opportunities for stakeholder engagement, allowing citizens and other actors to increase their own awareness of these issues while actively contributing to the adaptation planning within their own region. This participatory approach promotes transparency, builds trust between authorities and communities and supports more accepted and equitable adaptation decisions.

Environmental

By facilitating risk-informed spatial and adaptation planning, these solutions create environmental co-benefits by helping to manage natural systems in such a way as to protect them from climate hazards. The marine spatial planning framework supports the sustainable management of the surrounding coastal and marine environments by better integrating climate risks into planning decisions. For example, by avoiding development in areas vulnerable to floods, pressures on sensitive ecosystems are reduced, such as the risk of infrastructural debris.

Replicability – *Who can use this approach and how*

Scaling up modelling and preparation to Arctic hazards

Using modelling systems and stakeholder engagement to improve awareness of climate risks in different Arctic regions

Best suited for

This model is best suited for coastal Arctic regions exposed to multiple climate hazards, particularly where spatial planning and risk assessment play a central role in adaptation. This is especially relevant for such areas threatened by flooding, storm surges, avalanches and rockfall where informed preparation and rapid action are vital vital to protecting local communities. Municipalities and regional authorities with access to geospatial data, climate projections and hazard information can readily integrate similar tools into existing planning processes. The participatory approach based on citizen juries and VR is readily transferable to other contexts where visualising future climate scenarios can support public engagement, improve the understanding of risks and build acceptance around adaptation measures.

Stakeholders' role

The model leverages collaboration between different stakeholder groups to integrate perspectives and information from a variety of viewpoints. These groups were selected after a detailed mapping process. The groups identified included the state, government and political system; industry and the economic system; academia; and citizens, media and cultural actors. The demonstration site was led by the Arctic University of Norway.

Built-in scalable tools

This model integrated characteristics into the tools produced that support replication and scaling across different regions. For the marine spatial planning framework in particular, it is possible for users to integrate their own data using ArcGIS, enabling quick and effective scaling. The avalanche and slush flow assessment methodology can be transferred to other snow-prone regions by applying similar modelling approaches using local terrain, meteorological and hazard data. Likewise, for the stakeholder engagement methodologies, guidelines were developed to allow for successful replication in other settings.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Impetus project, as part of the EU Mission on Adaptation to Climate Change.

CaseStudy • DigitalTwin • Framework • Assessment • Guidelines • D1.1 • CORDIS

This solution is part of Mission Solutions Catalogue

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Cross-cutting

Strategy refinement | Enhanced governance | Technical support

Driving community-led action and adaptation in Torres Vedras, Portugal

Advancing inclusive governance, strategic planning and citizen engagement through the development of innovative frameworks

Climate hazards: **Main themes:**

Torres Vedras, Portugal

Contact: Laura Rodrigues,
Mayor of Torres Vedras
Torres Vedras City Council

Key figures

11+ stakeholders
engaged in developed climate action pact

1 complete
sustainable energy and climate action plan

Implementation timeline

2022–2025

Solutions

Supported by the mission implementation platform (MIP4Adapt), Torres Vedras addresses climate resilience through strategy refinement and participatory platforms.

1. **Climate action pact launch.**
The objective of Torres Vedras's climate action pact is to actively involve the municipality's different stakeholders in collaborative actions for decarbonisation and increased resilience. Through MIP4Adapt's technical support, the draft climate action pact was revised and refined. This resulted in its launch in October 2024, acting as a formal commitment for at least 11 signatories to work towards its common goals.

2. **Action plan guidance.**
The development of the municipality's sustainable energy and climate action plan (SECAP), which is a voluntary action linked to Torres Vedras being a part of the Covenant of Mayors, was supported by MIP4Adapt's BASE evaluation criteria for climate adaptation (BECCA) methodology and regional adaptation support tool (RAST). These tools, together with targeted coaching sessions, documented reviews and planning templates, helped assess gaps helped assess gaps and prioritise the necessary actions and opportunities for inclusive implementation.

3. **Climate Action Platform.**
MIP4Adapt supported the creation of the Climate Action Platform, which is a local multistakeholder initiative that brings together public institutions, businesses and civil society to scale community-led projects and deepen civic engagement.



Co-benefits

Environmental
Torres Vedras's climate adaptation efforts were refined and focused to address the municipality's most pressing climate hazards. In this way, through the development and revision of its main local climate plan, it is now better equipped to enhance its resilience. This is also reflected in the launch of the climate action pact, which solidifies the municipality's goal to work towards environmental resilience through projects such as those developed and implemented through the Climate Action Platform.

Social
The approach of Torres Vedras with regard to its climate governance places community engagement and social cohesion at its centre. This is demonstrated in the implementation of the climate action pact, which fosters a shared sense of ownership over adaptation efforts. Additionally, the capacity-building sessions provided through MIP4Adapt's technical assistance empowered those in charge of developing climate-related strategies in their ability to contribute to the municipality's adaptation efforts. The Climate Action Platform also deepens civil participation through its focus on community-led projects.

Economic
By addressing climate hazards, Torres Vedras's SECAP helps protect the municipality's future economic stability by reducing the economic losses caused by disaster recovery costs. Additionally, the climate action pact creates opportunities for public–private partnerships for project scaling. Lastly, the SECAP refinement resulted in the identification of suitable funding and financing sources for adaptation.



Replicability – *Who can use this approach and how*

Replicating the uptake of technical expertise: models, tools and finance pathways

From Torres Vedras to other municipalities

Best suited for
This approach is best suited for municipalities that have the political will to prioritise climate adaptation and align it with EU and national climate goals, but may lack the necessary expertise and technical tools. It is also ideal for situations where stakeholder engagement is a priority, in order to allow for its integration during the early stages of adaptation planning.

Stakeholders' model
This case uses a multistakeholder governance structure that revolves around three key actor groups. The Torres Vedras municipal leadership, in the shape of the city council, leads the political will for adaptation and is assisted by MIP4Adapt through the EU Mission on Adaptation to Climate Change's assistance to regions and local authorities. Local stakeholders are involved in the co-design and implementation of actions under the climate action pact

Built-in scaling tools

The ability to scale this approach comes from the transferability of the technical expertise provided. The BECCA and RAST methodologies can be applied to any municipality that requires strategy refinement and goal alignment. Apart from this, partnership initiatives such as the Climate Action Platform can be easily transferred to different contexts to encourage project scaling.

Funding pathways

This was primarily funded through the EU Mission on Adaptation to Climate Change's assistance to regions and local authorities through MIP4Adapt.

'The support from the EU Mission on Adaptation to Climate Change has been instrumental in helping Torres Vedras define clear climate priorities and strengthen its strategic vision. MIP4Adapt's technical assistance played a key role in developing structured adaptation pathways and promoting inclusive, stakeholder-driven approaches. It has greatly enhanced our capacity to advance innovative and effective climate strategies.'

Laura Rodrigues, Mayor of Torres Vedras, Torres Vedras City Council

MissionStory • **SuccessStory** • **ClimateAdapt** • **ClimatePact** • **ClimateActionPlatform**

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Cross-cutting

Stakeholder engagement | Digital tools | Business inclusion

Strengthening flood resilience through integrated planning and innovation in southern Denmark

Combining stakeholder engagement, digital tools and risk assessment to strengthen climate resilience

Climate hazards:

Main themes:

Esbjerg and Fanø, Denmark

Contact: Panepistimio Thessalias (Arsinoe project coordinator)

Key figures

1
digital flood model

1
economic damage model

Implementation timeline

2021–2025
Arsinoe project timeline

Solutions

As part of the Arsinoe project funded under the EU Mission on Adaptation to Climate Change, the region of southern Denmark developed an integrated approach to climate adaptation, combining innovative governance, stakeholder engagement, advanced modelling tools and economic assessments to strengthen resilience to flooding and other climate risks.

1. **Stakeholder engagement and participatory planning.**
   Through Arsinoe's systems innovation approach, local authorities, businesses, citizens and other stakeholders were actively involved in designing adaptation pathways. A digital engagement platform was developed for the Municipality of Esbjerg, while workshops explored opportunities for citizen participation in disaster risk management and climate resilience planning.
2. **Living lab for resilience planning.**
   A living lab brought together public and private stakeholders to co-develop long-term resilience pathways. The process increased awareness of flood risks, identified barriers to adaptation and fostered dialogue on solutions and investment opportunities.
3. **Flood modelling supported by artificial intelligence (AI).**
   An AI-powered digital twin was developed to simulate coastal and pluvial flooding scenarios and assess their social, economic and environmental impacts. The tool supports evidence-based decision-making and helps target adaptation measures to areas where they can deliver the greatest benefits.
4. **Economic risk assessment tool.**
   An economic damage assessment tool was created to estimate potential losses from climate hazards and support adaptation planning. The tool enables authorities and businesses to better understand climate risks and prioritise cost-effective resilience investments.

Co-benefits

Economic

Advanced flood modelling and economic risk assessment help authorities and businesses anticipate climate impacts and reduce future losses from flooding and infrastructure damage. By improving risk awareness and supporting informed investment decisions, the project strengthens economic resilience and encourages proactive adaptation planning.

Social

The project promotes community resilience through extensive stakeholder engagement, bringing together citizens, businesses, researchers and local authorities. Participatory planning increases public awareness of climate risks, strengthens trust in local decision-making and fosters a shared sense of ownership over adaptation actions.

Environmental

An improved understanding of flood dynamics supports the design of adaptation measures that protect ecosystems and reduce environmental degradation. This is particularly important in the Wadden Sea area, a UNESCO World Heritage Site, where better flood management can help safeguard biodiversity, coastal habitats and natural ecosystem functions while enhancing long-term climate resilience.

Replicability – *Who can use this approach and how*

Scaling integrated flood resilience planning across Europe

A transferable model combining data, governance and stakeholder engagement for climate risk management

Best suited for

This approach is particularly relevant for coastal and low-lying regions exposed to flooding from storm surges, sea-level rise and/or extreme rainfall, especially where critical infrastructure, economic assets and/or protected natural areas are at risk. It is well suited to municipalities and regions seeking to strengthen existing climate strategies through improved risk assessment, stakeholder engagement and evidence-based decision-making.

Stakeholders' role

The model relies on collaboration between local and regional authorities, research institutions, water and infrastructure managers, emergency services, private-sector stakeholders, investors and citizens. By bringing together diverse expertise and perspectives, stakeholders can jointly identify risks, develop resilience pathways and support the implementation of adaptation measures.

Built-in upscaling tools

The approach includes several transferable tools and processes. The AI-based digital twin can be adapted to different geographic contexts using local climate and topographical data. The economic damage assessment tool provides a methodology for estimating climate-related losses and prioritising investments. In addition, the living lab methodology and stakeholder engagement processes offer a practical framework for co-designing adaptation strategies in other regions.

Funding pathways

The approach was developed through the Horizon 2020-funded Arsinoe project. Similar initiatives can be supported through EU research and innovation programmes, regional development funds, national adaptation programmes and local resilience investments. The use of economic risk assessment tools can also help attract public and private financing by demonstrating the costs of inaction and the benefits of adaptation measures.

Mission story • **Arsinoe** • **CORDIS**

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Cross-cutting

Coastal climate resilience | Integrated climate adaptation | Collaborative approaches

Climate-resilient planning in the Basque Country

Strategic adaptation in action: governance, innovation and alignment with the EU Mission on Adaptation to Climate Change

Climate hazards: Main themes:

Basque Country, Spain

Contact: Climate Action Department, Ihobe

Key figures

75 %
of the population lives in coastal areas

23 %
of land is protected as natural heritage

Implementation timeline

2015–2050
Basque Country's climate change strategy timeline

Since 2022
Demonstrator for the EU Mission on Adaptation to Climate Change and project implementation across the region

Solutions

The Basque Country has developed a strong climate adaptation framework, combining long-term strategic planning with concrete action. A regional climate change law and adaptation roadmap translate the climate change strategy of the Basque Country to 2050 into operational resilience measures. Technical assistance through the Mission Implementation Platform has been key in advancing this work. The regional adaptation support tool of the European Environmental Agency has supported climate risk assessment, the development of adaptation pathways and the alignment of demonstrator projects with long-term resilience goals. This has enabled Ihobe, the Basque government's environment agency, to refine and prioritise its adaptation roadmap. Key regional demonstration initiatives include the following.

1. **Regions4climate.**
   A project funded under the EU Mission on Adaptation to Climate Change, implementing measures to strengthen coastal resilience by restoring estuarine dynamics, reconnecting marshes and wetlands and assessing the impacts of restoration on climate adaptation. The project also contributes to improving governance and spatial planning frameworks.

2. **Urbanklima 2050.**
A project funded by the EU LIFE Programme, targeting adaptation in coastal areas, urban environments and river basins. It implements integrated solutions combining mitigation and adaptation measures, including grey and green infrastructure, renewable energy deployment, sustainable mobility and ecosystem restoration.

3. **Climate shelters.**
Urban climate shelters in both indoor and outdoor public and private spaces have been developed, designed to provide safe and comfortable thermal conditions during heatwaves and protect vulnerable populations from extreme temperatures.

4. **Adaptation tools for firms, citizens and public administrations.**
Ihobe has developed a comprehensive set of publicly available tools, including climate scenario visualisation platforms, municipal risk assessment guidelines and catalogues of nature-based solutions. These tools support decision-making and empower stakeholders at all levels to take informed adaptation action.



Co-benefits

Economic
Adaptation measures in the Basque Country deliver strong economic co-benefits by adopting a preventive approach that helps avoid future damage, particularly by protecting critical infrastructure such as ports. In addition, the integration of mitigation and adaptation measures supports the development of new economic activities and job creation. Reduced health-related costs, resulting from improved environmental conditions, also contribute to long-term economic savings for the region.

Social
The strategy enhances regional sustainability by fostering citizen engagement and raising awareness, while providing communities with the tools to act. It also contributes to public health by proactively reducing heat stress through urban greening and climate-sensitive planning, ultimately improving overall quality of life.

Environmental
Several demonstrator projects focus on ecosystem restoration, urban green infrastructure and nature-based solutions. These interventions maximise environmental co-benefits by enhancing biodiversity, strengthening ecosystem resilience and improving the overall ecological quality of the region.



Replicability – *Who can use this approach and how*

The Basque Country's scalable model

Governance, funding and stakeholder engagement for scalable resilience

Best suited for
This approach is particularly suited for regions facing multiple climate challenges linked to coastal erosion, sea-level rise and flooding, and aiming to address climate action holistically through integrated mitigation and adaptation measures.

Stakeholders' role
The model relies on collaborative, multilevel governance, bringing together regional governments, municipal authorities, EU Mission coordination, citizens and stakeholders, along with researchers and academia to ensure both strategic alignment and effective implementation.

Built-in scalable tools
Collaboration across public and private stakeholders is a key enabler of scalability. The technical assistance provided through the mission supports the alignment of demonstrator projects with long-term resilience goals and helps identify high-impact interventions that can be replicated in other contexts.

Funding pathways
The approach is supported by a combination of regional and EU funding. A dedicated budget from the regional authority, Ihobe for research and innovation is complemented by EU funding to implement demonstrators and interventions that strengthen climate resilience.

Mission story • Urban klima 2050 • Region4climate • Basque Country climate strategy • Basque Country adaptation to climate change • Ihobe.es

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Cross-cutting

Modelling | Nature-based restoration | Tourism resilience

Strengthening multifunctional coastal areas in Catalonia, Spain

Using a combination of different solutions to strengthen key sectors along the Catalan coast

Climate hazards:

Main themes:

Catalonia, Spain

Contact: Queralt Plana – queralt.plana@eurecat.org
Gabriel Borràs – gborras@gencat.cat

Key figures

600 km
of Catalan coast vulnerable to climate impacts

Multiple
sectors targeted

Implementation timeline

5 years
The project spans from 2021 to 2025

Solutions

The Impetus project aimed to accelerate the EU's climate-neutrality and adaptation efforts by developing practical, scalable actions that strengthen resilience across communities, sectors and regions. It worked to empower stakeholders with the knowledge, data and innovation capacity to co-design, implement and sustain effective climate resilience solutions across seven EU biogeographical regions. The demonstrator tackles the coastal biogeographical region, with Catalonia as a test bed. This region is facing worsening climate hazards, including rising temperatures, sea-level rise and reduced precipitation. The various solutions implemented include the following.

1. **Resilient tourism climate visor.**
   This digital tool supports resilient tourism activities. Available in the form of a dashboard, it allows tourists – and residents, if they wish – to make informed decisions on what recreational activities are suitable for that specific day depending on the local weather conditions. This facilitates tailored tourism experiences that align with the day-to-day fluctuations in weather patterns.

2. **Species distribution models.**
Using species distribution models, this tool projects current and future distributions of key waterbird species under different climate change scenarios within the Ebro Delta, which is particularly vulnerable to climate impacts. It was developed by combining different datasets including species occurrence records and environmental variables, such as temperature and precipitation.

3. **Bathing water simulation.**
Sewer overflows may become more prevalent due to climate hazards such as storm surges, heavier precipitation and sea-level rise. This tool explores how sewer overflows and sea conditions interact to impact the water quality in local bathing areas. This is done using hydrodynamic models, allowing users to visualise pollutant dispersion patterns over time. These contaminants include pathogens such as E. coli, which can cause symptoms such as stomach pain and nausea.

4. **Dune restoration framework.**
This framework was developed to support the restoration of dune habitats on tourist beaches. It brings together multiscale indicators to assess the resilience of dunes to climate hazards, along with an evidence-based evaluation technique for understanding the effectiveness of nature-based restoration measures such as sand fences. Guidelines for the practical design and implementation process of such nature-based solutions are also included. This framework allows different stakeholders to diagnose areas of dune degradation, followed by the prioritisation and selection of workable restoration actions.

5. **Drinking water strategies tool.**
This tool tackles the need for increased resilience in terms of potable water being contaminated by climate-driven harmful algal blooms. The approach combines predictive models and real-time monitoring to predict the occurrences of cyanobacterial blooms. This analysis is paired with photocatalytic treatment technologies to remove such toxins from the water.



Co-benefits

Economic

The solutions implemented in Catalonia provide several economic co-benefits by simultaneously reducing the costs associated with climate impacts and supporting key local economic sectors. The resilient tourism climate visor is a clear example of this, as it helps protect the continuity of the region's tourism operations in the face of changing climatic conditions, protecting local livelihoods that depend on this sector and the region's economy as a whole. Dune restoration, with a particular focus on tourist beaches, may help reduce coastal erosion, reducing the need for large-scale spending on engineered coastal defences while again preserving popular – and hence profitable – tourism attractions. The same applies to the bathing water analysis, which can help prevent unnecessary beach closures and associated losses in tourism revenue. The drinking water management tool, on the other hand, helps to limit treatment costs for water utilities. Together, these solutions strengthen the long-term economic resilience of coastal communities.

Social

The coastal demonstration site contributes to the community resilience of the region, directly improving public health and safety. The bathing and drinking water tools provide early information on water quality risks, reducing the public's exposure to harmful pathogens. The resilient tourism climate visor helps tourists and residents alike to make informed decisions about outdoor recreational activities based on local weather conditions, improving both their safety and their comfort.

Environmental

The solutions enhance ecosystem resilience and support biodiversity conservation within vulnerable coastal ecosystems that are at the forefront of climate hazards. Species distribution models help identify areas where climate change is likely to alter suitable habitats for vulnerable waterbird species. This provides a basis for the formulation of targeted conservation interventions. Similarly, by facilitating dune restoration, the dune restoration framework helps strengthen natural coastal protection, which, in turn, protects more inland habitats from hazards such as sea-level rise while also restoring the native habitats and wildlife of the dunes themselves. Additionally, improved management of bathing and drinking water quality contributes to healthier aquatic ecosystems.

Replicability – *Who can use this approach and how*

Scaling up the resilience of coastal tourist regions

Using different tools to strengthen different sectors

Best suited for

This model is best suited for coastal regions facing increasing vulnerability to climate hazards such as sea-level rise and coastal erosion, resulting in impacts such as declining water quality and availability, and biodiversity loss. It is particularly relevant to coastal regions where tourism is a key economic sector, taking both recreational activities and safe resource use into account. The presence of vulnerable ecosystems is an additional aspect of this model, with a focus on biodiversity modelling and nature-based restoration. While demonstrated in Catalonia, the solutions can be adapted to other European coastal regions by incorporating local environmental conditions and environmental and climate datasets.

Stakeholders' role

The model relies on collaboration between different stakeholder groups. When the solutions were being developed, the relevant actors were engaged in a co-creation process. Those involved were in keeping with the intended uses and users of the solutions. For example, for the dune restoration framework, natural park managers and local authorities were engaged. Policymakers were also engaged for other solutions, such as those involved with sustainable tourism in the area. Engagement activities were carried out mainly for tool diagnosis and exploration purposes, along with the opening of debates on new potential users and the future implementation of the solutions.

Built-in scalable tools

This model combines digital decision-support tools with adaptable nature-based solutions, making the approach readily scalable and transferable to different regions. Digital tools such as the resilient tourism climate visor, species distribution models, bathing water simulation and drinking water strategies tool can be used in different locations by integrating local environmental, climatic and socioeconomic datasets into the systems, thus tailoring it to the local conditions. Similarly, the dune restoration framework provides concrete guidelines, including a structured methodology and indicators, that can be used in different coastal settings. Together, these tools are adjustable in such a way as to enable other regions to scale while taking site-specific characteristics into account.

Funding pathways

The pilot case was developed through the Horizon Europe-funded Impetus project, as part of the EU Mission on Adaptation to Climate Change.

Impetus.eu • CaseStudy • Model • Dune • BathingWater • DrinkingWater • Tourism • CORDIS • D1.2

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Cross-cutting

Aquaculture | Monitoring | Digital innovation

Strengthening the resilience of shellfish aquaculture in Galicia, Spain

Using digital innovations to better understand and adapt to the climate hazards affecting shellfish aquaculture farms in coastal Galicia

Climate hazards:

Main themes:

Galicia, Spain

Contact: Antwerp University
TransformAr coordinator

Key figures

3
innovative solutions

Implementation timeline

2021-2025
TransformAr project timeline

Solutions

The TransformAr project aimed to accelerate transformational adaptation to climate change by developing and demonstrating innovative solutions to tackle water-related climate hazards in vulnerable regions across Europe. The project co-created and tested scalable interventions in six demonstration regions, supporting informed decision-making to strengthen regional climate resilience. The fifth demonstration site was located in Galicia (Spain), where three innovative solutions were developed to strengthen the resilience of shellfish aquaculture, one of the region's most important economic sectors.

1. **Resilience index for adaptive governance.** The resilience index is a decision-support tool based on a mathematical model that assesses the adaptive capacity of the local mussel aquaculture value chain to climate hazards. It combines climate projections, historical environmental and production data, and resilience indicators to identify vulnerabilities and evaluate adaptation options. The tool enables policymakers, aquaculture managers and producers to prioritise adaptation measures, compare future scenarios and support long-term planning.

2. **Intertidal monitoring solution (Interm).** The Interm solution is a climate adaptation monitoring system developed for Galicia's intertidal clam harvesting areas. It combines field surveys of sediment characteristics, seabed morphology, tides and currents with numerical modelling to understand and predict how climate-driven changes in sediment dynamics affect shellfish habitats. The system provides evidence to support fisheries managers and shellfish harvesters in protecting and sustainably managing these coastal ecosystems.

3. **Mussel raft monitoring.**
The mussel raft monitoring solution strengthens mussel aquaculture through real-time digital monitoring. An autonomous internet-of-things system continuously collects production and environmental data directly from mussel rafts, including oceanographic conditions and mussel growth. This enables producers to optimise farm management during climate-related events, improving productivity and strengthening resilience.

Co-benefits

Economic
The Galicia demonstrator generates significant economic benefits by strengthening the resilience of one of the region's flagship blue economy sectors. Digital monitoring and climate-informed management help reduce production losses, improve operational efficiency and lower maintenance and recovery costs following extreme events. Together, these innovations enhance the long-term competitiveness of Galicia's aquaculture sector while supporting future investment.

Social
By strengthening shellfish aquaculture, the project also reinforces the resilience of the coastal communities whose livelihoods depend on it. A participatory approach involving producer organisations, researchers and public authorities ensured that the solutions reflected local needs and encouraged knowledge sharing. The project also helps safeguard employment, preserve cultural heritage and strengthen communities' capacity to adapt to climate change.

Environmental
The Galicia demonstrator contributes to healthier and more resilient coastal ecosystems by improving the monitoring of water quality, sediment dynamics and climate-related pressures, including extreme weather events, ocean acidification, harmful algal blooms and fluctuations in mussel seed availability. By integrating scientific knowledge with digital technologies, it supports the sustainable management of marine resources, protects biodiversity and strengthens the resilience of coastal habitats.

Replicability – *Who can use this approach and how*

Scaling up climate-smart shellfish aquaculture

Innovative approaches to better manage shellfish farms in a changing climate

Best suited for
This model is best suited for coastal regions where aquaculture plays an important economic role and where climate change threatens production through changing marine conditions. It is particularly relevant for regions with significant shellfish production seeking to strengthen resilience through digital monitoring, climate-informed management and evidence-based decision-making.

Stakeholders' role
The model relies on a participatory approach bringing together producers, researchers, public authorities and technical experts to co-design and implement adaptation measures. This collaborative process ensures that solutions respond to local needs while encouraging long-term uptake. Technical development was led by the Centro Tecnológico del Mar and research groups from the University of Vigo.

Built-in scalable tools
The three solutions have all reached technology readiness level 7 or above, demonstrating their maturity and potential for deployment in other coastal regions. They are designed for operational use by end users and can be transferred to similar aquaculture systems, provided local environmental and production data is available for calibration.

Funding pathways
The pilot was developed through the Horizon Europe-funded TransformAr project, under the EU Mission on Adaptation to Climate Change.

TransformAr.eu • CaseStudy5 • CORDIS • D5.6 • D5.8

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Cross-cutting

Cross-sectoral collaboration | Coordination | Cross-siloed approaches

Climate-resilient planning in the Valencia region

Policy leadership and cross-sector collaboration driving climate adaptation in Valencia

Climate hazards:

Main themes:

Valencia, Spain

Contact: Javier Marzo Muñoz, environmental technician, Climate Change Adaptation Service, Generalitat Valenciana (GVA)

Key figures

23 255 km²
regional extension

EUR 940 000
secured funds for the implementation of key climate actions

Implementation timeline

2018–2030
Valencia's regional climate strategy

2023–2026
Soteria

2024–2028
Desirmed

Solutions

To strengthen resilience in the face of escalating climate risks, the Valencia region is developing a comprehensive climate change mitigation and adaptation plan. The plan aims to move from planning to implementation and provides a coherent framework that improves coordination across government departments and sectors. To support this implementation phase, the region participates in several EU-funded projects, notably the following.

1. **Soteria**
   Soteria (solutions testing for regions through insurance for climate adaptation) develops innovative approaches to strengthen climate resilience by addressing the insurance gap and promoting sustainable adaptation. It supports public–private collaboration, explores new financing mechanisms and improves public procurement strategies. The project also develops nature-based solutions investment maps and regional data hubs to guide evidence-based decision-making and support the restoration of coastal wetlands and sustainable land use.

2. **Desirmed**
   Desirmed (demonstration and mainstreaming of nature-based solutions for climate resilient transformation in the Mediterranean) focuses on forest fire prevention and biodiversity protection, particularly in high-risk areas such as the wildland–urban interface. It combines research, technology and capacity building to improve early detection and reduce catastrophic wildfire risks. The project also supports upgraded meteorological monitoring (via the Sideinfo platform), the creation of green firebreaks and circular water management solutions.
   Both Soteria and Desirmed are funded under the EU Mission on Adaptation to Climate Change, helping the region test, scale up and accelerate innovative adaptation solutions.



Co-benefits

Economic

Valencia's proactive approach to securing funding has delivered strong results, with successful applications totalling over EUR 940 000 to support the implementation of key climate actions. These resources have enabled the region to scale up its efforts, strengthen ongoing initiatives and accelerate progress towards its sustainability goals in a more coordinated and sustained way.

Social

Valencia has strengthened interdepartmental collaboration by breaking down silos and improving coordination across sectors. This enables more coherent planning coherent planning and more effective implementation of climate initiatives across the administration. It has also improved the efficiency of resource allocation and supported a more integrated approach to addressing climate risks at the regional and local levels.

Environmental

The region's climate adaptation approach systematically promotes the scaling up of nature-based solutions and ecosystem-based interventions. These approaches are integrated into planning and implementation to ensure multiple co-benefits, including enhanced flood and heat resilience, improved ecosystem services and positive impacts on regional biodiversity.

Replicability – *Who can use this approach and how*

Replicating Valencia's climate adaptation approach

Valencia's experience shows how cross-silo collaboration and cross-sector coordination can strengthen climate adaptation planning and implementation at the regional level

Best suited for

This approach is particularly suited for regions exposed to multiple climate hazards and that aim to build resilience through comprehensive and holistic strategies. It is especially relevant for territories where adaptation requires coordination across several policy areas and levels of governance.

Stakeholders' role

The model relies on strong cooperation between regional and local authorities, supported by structured interdepartmental collaboration. Technical assistance through the EU Mission on Adaptation to Climate Change has played an important role in strengthening planning and implementation capacities. On-the-ground projects further engage relevant stakeholders from both the public and private sectors, reinforcing local cooperation and ensuring practical delivery of solutions.

Built-in scalable tools

A key feature of this approach is cross-silo and interdisciplinary collaboration, which helps establish coordination mechanisms for a more unified approach to climate adaptation across sectors. In addition, projects implemented on the ground serve as pilot initiatives that are designed with replicability in mind, enabling other regions to adapt and scale up successful solutions.

Funding pathways

EU funding has acted as a catalyst for accelerating the implementation of climate adaptation solutions. Innovative financing approaches are also being tested, particularly through the development of public–private partnerships that support long-term investment in resilience.

> *'In the Valencia region, we recognise the need of implementing climate adaptation efforts swiftly to safeguard our region's future. The EU Mission on Adaptation to Climate Change has provided invaluable support, enabling us to accelerate our actions and collaborate with European partners to address pressing climate challenges effectively. We would encourage regions in a similar situation to Valencia to get involved in any way that they can.'*
>
> **Javier Marzo Muñoz, environmental technician, Climate Change Adaptation Service, GVA**

Soteria • Desirmed • GVA • Mission success story • Estrategia Valenciana de Energia y Cambio Climatico

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Cross-cutting

Transnational cooperation | Systemic approach | Interconnected challenges

Climate resilience in the Black Sea region: an integrated approach

Arsinoe's transnational coordination for addressing the interconnected human-induced drivers undermining regional health and resilience

Climate hazards:

Main themes:

Black Sea, Bulgaria, Greece, Romania, Turkey

Contact: Panepistimio Thessalias, Greece, Arsinoe project coordinator

Key figures

Source-to-open-sea
watershed management approach

Collaboration
across
4 countries

Implementation timeline

2021–2025
Arsinoe project duration

Solutions

Funded under the EU Mission on Adaptation to Climate Change, the Arsinoe project introduced an integrated approach to Black Sea resilience, linking land, river and marine ecosystems through a unified '**source-to-sea**' framework. By combining artificial intelligence, real-time monitoring and stakeholder-driven nature-based solutions, the project enabled transnational, data-informed watershed management, setting a new standard for climate-adaptive strategies in vulnerable coastal regions. The project developed the following.

1. **Digital twin.**
   A digital twin was developed for the Haliacmon river Basin, combining real-time hydrological simulations, integrated models and sensor data. This enables dynamic resilience assessments and supports climate-adaptive water management.
2. **Innovative wetland monitoring.**
   Advanced unmanned-aerial-vehicle-based monitoring using thermal and multispectral sensors was deployed to map habitat conditions in the Ropotamo wetland. This was complemented by fixed sensors enabling real-time water quality monitoring. Together, these tools allow for dynamic assessment of pollution trends, ecosystem self-purification capacity and environmental risks.
3. **Nature-based solutions.**
   Nature-based interventions in the Danube delta include biofiltration bacteria trials to restore degraded ecosystems and salt-tolerant agricultural practices to rehabilitate salinised soils.
   These measures strengthen climate resilience while preserving biodiversity thereby, demonstrating scalable approaches to integrated land–water management.
4. **Advanced marine monitoring and predictive modelling.**
   In Turkey, research vessels collected *in situ* data such as temperature, pH, nutrients and oxygen levels. This was complemented by artificial-intelligence-enabled smart sensors monitoring carbon dioxide, salinity, turbidity and biofouling risks. The data is integrated into biogeochemical models to assess future risks and support climate-adaptive biodiversity management.

Co-benefits

Economic

Arsinoe's integrated solutions in the Black Sea region support local livelihoods by introducing climate-resilient agricultural practices that maintain productivity on degraded lands.
At the same time, the project protects and restores ecosystem services through low-cost nature-based solutions, including wetland restoration and improved marine monitoring, helping reduce pollution pressures.
These interventions contribute to long-term economic stability for communities while safeguarding the natural assets underpinning agriculture, forestry, tourism and coastal economies.

Social

Arsinoe enhances social resilience by promoting climate-adaptive practices, such as nature-based agriculture and real-time water monitoring, that support livelihoods in agriculture, fisheries and tourism.
Through cross-sector collaboration, the project strengthens alignment between policy frameworks and community needs, while protecting ecosystem services essential for public health, food security and cultural heritage. This contributes to long-term well-being and sustainability for local populations.

Environmental

Arsinoe delivers significant environmental co-benefits through the restoration of degraded ecosystems and improved monitoring of water and marine health. Real-time data on pollution, oxygen levels and nutrient loads, combined with unmanned aerial vehicle surveys, digital twins and marine expeditions, enables proactive climate adaptation. These tools help protect biodiversity hotspots and reduce vulnerability to algal blooms, salinity shifts and habitat degradation, strengthening the resilience of riverine, wetland and coastal ecosystems.

Replicability – *Who can use this approach and how*

Replicating Arsinoe's scalable framework for climate resilience

Funding pathways, stakeholder engagement and adaptable tools for transboundary watersheds

Best suited for

Arsinoe's integrated approach is particularly replicable for coastal and marine regions with transboundary watersheds, where shared environmental challenges require systemic, cross-border collaboration. It is particularly relevant in contexts where activities and pressures in one part of a river basin or coastal system can affect ecological conditions and risk profiles elsewhere across the same system. In such cases, stakeholders can adopt Arsinoe's source-to-sea framework, which combines real-time environmental monitoring, digital modelling and nature-based solutions to collectively address climate risks across entire catchments.

Stakeholders' role

The project brought together a broad range of stakeholders, including public authorities at the regional and local levels, non-governmental organisations and academia, along with local communities and citizens. Citizen knowledge and local expertise were actively integrated into the co-design of solutions, ensuring that interventions are grounded in real-world needs and territorial specificities.

Built-in scalable tools

Arsinoe combines modular, low-cost nature-based solutions interventions and monitoring technologies with participatory stakeholder engagement to ensure solutions are locally tailored and widely adaptable. The project's digital twin models and metaverse-based data visualisation enable transferable climate risk assessments, while cross-sectoral workshops and community co-design align interventions with local needs, cultural practices and governance structures. The source-to-sea framework supports replication, making Arsinoe's approach scalable for regions facing similar climate and environmental challenges.

Funding pathways

Arsinoe has been funded through the EU Mission on Adaptation to Climate Change. The solutions developed and tested within the project provide a strong basis for upscaling through blended, multisource financing approaches, combining public funding, private investment and potentially other innovative financial instruments to support long-term implementation and replication.

Mission story • **Arsinoe funding** • **CORDIS**

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Cross-cutting

Technical assistance | Stakeholder engagement | Expert validation

Enhancing Vilnius' climate adaptation plan, Lithuania

Using tailored technical assistance to strengthen preparedness for climate adaptation planning and implementation

Climate hazards:

Main themes:

Vilnius, Lithuania

Contact: Vilnius City Municipality (general contact)
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Key figures

1
quality assurance check

Analysis of
many
adaptation options

Implementation timeline

2023–2025

Solutions

Vilnius actively participates in two EU missions: the Mission on Climate Neutral and Smart Cities and the Mission on Adaptation to Climate Change, placing climate resilience at the core of its urban development strategy. The city has introduced a climate change agreement as a shared commitment to climate neutrality alongside a climate neutrality promotion programme that supports community-driven initiatives. In parallel, Vilnius has advanced its climate adaptation plan, strengthening its capacity to prepare for future climate risks through evidence-based measure selection and stakeholder co-creation. This process was supported through tailored technical assistance provided by the Mission Implementation Platform (MIP4Adapt).

1. **Quality assurance of risk assessment.** MIP4Adapt carried out a structured quality review of the city's climate risk assessment. This ensured alignment with EU recommendations and best practices, strengthening the robustness and credibility of the adaptation plan and providing a solid foundation for its implementation.
2. **Analysis of adaptation options.** Comprehensive screening and analysis of potential adaptation measures were conducted. This ensured that the selected actions were targeted, evidence based and capable of addressing key climate risks affecting Vilnius, including rising temperatures and increasing rainfall extremes.
3. **Stakeholder engagement support.** Through MIP4Adapt coaching the city developed a tailored stakeholder engagement strategy for the adaptation planning process. This enabled the structured involvement of citizens, businesses and experts from the outset, ensuring that the plan reflects local needs and strengthens legitimacy and ownership.
4. **Continuous review and updating.** Given the evolving nature of climate risks, the adaptation plan is designed as a dynamic framework. Regular reviews and updates ensure that measures remain relevant, effective and responsive to emerging climate impacts over time.



Co-benefits

Economic

The development and validation of the Vilnius climate adaptation plan reduces long-term economic losses by improving preparedness for climate-related disruptions. By prioritising scientifically assessed adaptation measures the city enhances the efficiency of public investment and strengthens the protection of critical infrastructure, supporting long-term economic stability.

Social

The adaptation plan strengthens social resilience by improving the city's preparedness for climate impacts affecting communities and essential services. Inclusive stakeholder engagement throughout the planning process increases transparency, builds trust and fosters a strong sense of ownership among citizens and local stakeholders, supporting more effective implementation.

Environmental

The validated adaptation measures deliver significant environmental benefits including urban greening, improved water management and enhanced ecosystem resilience. These actions help reduce run-off, improve air and water quality and protect the Neris River ecosystem. Over time they also contribute to carbon sequestration and support Vilnius's broader goal of climate neutrality by 2030, while creating a healthier urban environment.

Replicability – *Who can use this approach and how*

A scalable model for strengthening climate adaptation planning and supporting evidence-based decision-making

How this approach can be adapted and applied across different regional and local contexts

Best suited for

The model is relevant for cities and regions with a strong political commitment to climate action that seek to strengthen evidence-based climate adaptation planning and improve the integration of climate risk information into decision-making. It is particularly useful for authorities aiming to structure adaptation planning in a more systematic and transparent way, especially where technical capacity needs to be reinforced.

Stakeholders' role

The model relies on a multilevel governance approach. The Vilnius team worked in coordination with the MIP4Adapt Member State facilitator for Lithuania, ensuring alignment between local priorities and national context. Technical experts from the MIP4Adapt support teams contributed to the development and review of the climate adaptation plan, including climate risk assessment quality checks and the analysis of adaptation options.

Built-in scaling tools

Scalability is supported by structured and transferable methodological tools, including templates for risk assessment review, adaptation option screening and stakeholder engagement processes. These enable consistent application across cities while allowing adaptation to local climate risks, governance structures and planning systems.

Funding pathways

Implementation and further development of adaptation measures can be supported through a combination of EU cohesion policy funds, national climate adaptation programmes and municipal investment planning. This blended approach helps ensure continuity beyond the planning phase and supports the gradual upscaling and operationalisation of priority adaptation actions.

> *'This climate adaptation plan will ensure that the city is prepared for future climate challenges while strengthening its overall resilience. It will help to create healthier living conditions and reduce the city's vulnerability to more frequent storms, heavy rainfall and heatwaves.'*
>
> **Agnė Eigminienė, Director of Climate Neutral Vilnius**

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Cross-cutting

Preparedness planning | Digital tools | Risk mapping

A regional tool to visualise climate impacts in Drenthe, Netherlands

Using interactive story maps to assess drought, flooding and subsidence risks in the Netherlands

Climate hazards:

Main themes:

Drenthe, Netherlands

Contact: j.brechetaue@drenthe.nl

Key figures

3+
hazards mapped on the DAB

Implementation timeline

From 2022

Solutions

Drenthe has developed the Drenthe Adaptation Picture (DAB), an innovative regional climate adaptation support platform that brings together multiple datasets into one integrated decision-support system. Using interactive maps, it informs both policymakers and the public and turns complex climate risk information into tangible insight. The platform strengthens climate resilience by combining hazard mapping, sectoral analysis and spatial planning support.

1. **Flood risk data.**
The DAB identifies where flood risk is most acute across Drenthe, drawing on data on extreme rainfall, storm surges and fluctuating river levels. These maps allow the province to clearly pinpoint priority zones and direct flood prevention and resilience investments where they are needed most.

2. **Drought risk data.**
The platform highlights areas exposed to increasing drought stress, driven by rising temperatures and dependence on external water systems such as the IJsselmeer. This enables proactive water management strategies and supports more resilient allocation and use of scarce water resources.

3. **Soil subsidence data.**
The DAB maps current and future soil subsidence risks linked to soft soil drainage, mineral extraction and climate pressures. It goes beyond observation by modelling where subsidence is likely to intensify, helping planners anticipate structural risks and adjust land-use decisions before damage occurs.

4. **Climate impacts across sectors.**
The platform also captures the wider climate impacts on key sectors of the regional economy, including agriculture, recreation and the built environment. It connects physical risks to real-world consequences, making climate change tangible for decision-makers and stakeholders.



Co-benefits

Economic
The DAB delivers strong long-term economic value by shifting decision-making from reactive to preventive. By identifying flood, drought and subsidence hotspots early, it helps avoid costly infrastructure damage and misallocated investments. It strengthens agricultural resilience by enabling targeted drought responses and improves water efficiency, reducing pressure on shared systems such as the IJsselmeer. The result is smarter spending, fewer losses and more resilient regional productivity.

Social
Built through a collaborative process, the DAB makes climate risk visible, tangible and understandable. It empowers citizens, farmers, planners and local stakeholders to see the risks affecting their own communities and to engage in adaptation choices. This transparency strengthens trust in public authorities, fosters shared responsibility and builds stronger community ownership of climate resilience.

Environmental
The DAB actively supports nature-positive adaptation by guiding interventions towards the most appropriate locations and solutions. It helps prioritise ecosystem-based measures such as wetland restoration and sustainable water retention. At the same time, it reduces pressure on fragile systems by discouraging excessive groundwater extraction and unsustainable drainage practices. In doing so, it helps limit peat degradation and associated greenhouse gas emissions while improving overall ecosystem health.



Replicability – *Who can use this approach and how*

Mapping climate hazards: from Drenthe to other regions

A scalable blueprint for turning fragmented climate data into tangible, place-based decision support systems

Best suited for
This approach is particularly well suited to regions exposed to flooding, drought and soil subsidence, especially where peat-rich soils, soft ground conditions or mixed urban–rural landscapes increase vulnerability. It is also highly relevant for territories dependent on fragile or external water supplies and for regions where climate risks are not yet fully embedded in public awareness or planning practice.
The model is especially valuable where technical capacity for advanced climate modelling is limited. By simplifying complex datasets into clear, map-based insights it enables administrations to move from fragmented information to concrete, place-based decision-making without requiring high-end in-house modelling expertise.

Stakeholders' role

The DAB relies on a collaborative governance structure that is readily replicable. Regional or provincial authorities provide strategic leadership and ensure alignment with spatial planning and adaptation priorities. Technical providers develop and maintain the digital infrastructure, data integration and mapping tools. Public authorities and decision-makers use the outputs directly to guide investment choices, land-use planning and risk management decisions. Local stakeholders, including citizens, farmers and businesses, engage with the platform to better understand their exposure, build awareness and support the implementation of adaptation measures. This distributed model ensures that the platform functions not only as a technical tool, but also as a shared governance space for climate action.

Built-in scalable tools

The DAB is designed as a modular system that can evolve progressively and adapt to very different territorial contexts. Regions can start with a limited set of climate hazards and expand over time as data availability, capacity and policy ambition grow. The platform structure allows for phased deployment, beginning with pilot areas before scaling up to full regional coverage, which reduces entry barriers and supports early learning.

Importantly, the system is not fixed to one type of risk: it can be reconfigured to reflect the dominant climate challenges of each region, whether heat, drought, flooding or subsidence. Its accessibility is reinforced by a user interface designed for both technical specialists and non-expert users, ensuring that it can be embedded not only in expert planning environments but also in everyday governance and public communication.

Funding pathways

The DAB was initially developed through internal funding by the Province of Drenthe, showing that a strong regional mandate and integration into existing planning systems can be enough to launch this type of platform without complex financing structures. Its replicability is strengthened by its phased financing potential. After initial deployment, development can be progressively supported through a mix of regional budgets and external funding sources, including climate adaptation, innovation and territorial development programmes. Because the platform is modular, investment can be spread over time, aligning costs with expansion and avoiding large upfront commitments while ensuring long-term sustainability.

> *'The platform provides access to knowledge and information to help us better understand what climate change means for Drenthe, and to guide our choices regarding the environment, for now and for the future. The tool facilitates discussions regarding the effectiveness and necessity of environmental measures.'*
>
> **Henk Jumelet, executive board member for the Province of Drenthe**

Mission story • **Klimaateffectatlas** • **Climate Adaptation Services** • **DAB Futurium**

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Cross-cutting

Urban greening | Enhanced governance | Technical support

Making climate action a political priority in Valongo, Portugal

Planting trees and working towards effective climate strategies that address community needs

Climate hazards:

Main themes:

Valongo, Portugal

Contact: Gisela Martins, Municipality of Valongo

Key figures

1 new governance structure
to co-design green policies

2 200 trees planted
in six months

Implementation timeline

From 2023

Solutions

Valongo addresses climate risks through nature-based solutions and participatory platforms.

1. **'Every street with a tree' initiative.**
This initiative is a core part of the municipal climate action plan, and its goal is to plant at least one tree in every street of the municipality through voluntary reforestation actions, or the implementation of other forms of green infrastructure, such as green rooftops, if a tree is not possible. More than 2000 native trees and shrubs have been planted in just six months. This initiative is paired with awareness raising and interventions for controlling invasive species. The reforested areas are also utilised as outdoor classrooms for citizen education.

2. **Urban tiny forest network.**
This network is another core component of the municipal climate action plan and is made up of a series of tiny forests. No chemicals or fertilisers are used in their upkeep. The forest areas are also utilised as outdoor classrooms for citizen education.

3. **Municipal Council for the Environment and Climate Action.**
The EU Mission on Adaptation to Climate Change supported the creation of a governance structure in the form of the Municipal Council for the Environment and Climate Action by guiding its structure and regulations. This council acts as a participatory platform that brings together local and regional stakeholders for the co-design of green, equitable policies.

Co-benefits

Environmental

The greening interventions aim to expand green spaces in urban areas, which will have multiple environmental benefits in the short to long term. These include increased carbon sequestration and the mitigation of the urban heat island effect in the densely populated municipality, while reducing the severity of flooding episodes by increasing permeable soil cover. Air quality will also be improved, creating climate shelters for residents. These impacts will have the overall effect of enhancing biodiversity in the area, complemented by efforts to control invasive species populations.

Social

The implementation of Valongo's greening initiatives is mainly done through voluntary reforestation actions, enhancing citizens' environmental responsibility and community stewardship. Additionally, the overall increase in green urban spaces will contribute to improving citizens' quality of life and mental well-being, particularly after the Council for the Environment and Climate Action identified local schools as being highly impacted by the urban heat island effect. Lastly, the newly formed council will allow for a more inclusive approach to policy development, ensuring more local and regional stakeholders are involved in the process.

Economic

The urban greening initiatives ultimately reduce the long-term costs of climate disasters and reduce reactive spending for recovery, such as on agricultural losses and infrastructure damage due to drought and flooding respectively. Greener areas may also increase the value of local homes and boost local tourism, while creating employment opportunities such as maintenance jobs.

Replicability – *Who can use this approach and how*

Replicating volunteer-based greening projects and engagement platforms: models, tools and finance pathways

From Valongo to other municipalities

Best suited for

This model is well suited for small and medium-sized municipalities facing urban climate risks, such as heatwaves, flooding and biodiversity loss, and seeking cost-effective, community-driven nature-based solutions. It is particularly relevant where local capacity is limited but strong potential exists to mobilise citizens and partnerships and utilise local knowledge to deliver adaptation on the ground.

Stakeholders' role

The approach relies on a collaborative governance structure. The municipality leads strategic direction and project coordination, while citizens, local experts and community groups actively contribute to greening actions. A dedicated municipal council on environment and climate action brings together stakeholders to support dialogue, coordination and shared decision-making.

Built-in scalable tools

Scalability is driven by the simplicity and adaptability of both the greening methods and the governance model. Volunteer-based urban greening activities can be replicated in different neighbourhoods and cities, enabling the rapid expansion of nature-based solutions. The participatory council model can also be transferred to strengthen stakeholder engagement, improve coordination and support knowledge exchange in other municipalities.

Funding pathways

Implementation typically combines EU funding with national and municipal resources. EU programmes supporting climate adaptation can help kick-start initiatives, while local budgets and project-based financing ensure continuity and upscaling of urban greening actions over time.

> *'Valongo's journey under the Mission on Adaptation is a powerful testament to how collaboration, vision and unwavering commitment can transform climate ambition into action. When communities unite around a shared purpose, local action becomes the driving force for global change and a more sustainable future.'*
>
> **Gisela Martins, Head of Environment Division, Municipality of Valongo**

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Cross-cutting

Funding opportunities | Stakeholder engagement | Stakeholder-led adaptation

Enhanced local action and governance in Andalusia, Spain

Empowering local action through governance, funding and engagement

Climate hazards: Main themes:

Andalusia, Spain

Contact: Imaculada Tula, Andalusian Climate Change Office

Key figures

1 practical guide
to help local governments identify funding opportunities

6 administrative departments
brought together to develop adaptation strategies

Implementation timeline

2023–2025

Solutions

The project used a combination of institutional capacity building, practical tools and stakeholder engagement to accelerate local climate adaptation.

1. **Practical funding guide.**
The Andalusian region developed a guide for climate adaptation financing in Andalusian municipalities with support from the Mission Implementation Platform. It includes templates, step-by-step guidance and practical annexes to facilitate implementation. The guide helps local governments identify EU, regional and national funding opportunities, structure bankable adaptation projects and align proposals with the Andalusian climate action plan.

2. **Institutional capacity building.**
The region organised cross-departmental training and workshops involving staff from six regional government departments to strengthen stakeholder engagement, climate communication and awareness-raising capacities. These activities also supported better interdepartmental coordination by aligning adaptation efforts with existing regional policies.

3. **Citizen and stakeholder engagement**
The region prioritised engagement through initiatives such as the climate ambassadors programme, which mobilises local advocates at high-visibility events (e.g. the Andalusian International Congress on Climate Change). It also organised public awareness activities, including a roundtable on citizen engagement and an Adaptation Day in Granada, and developed targeted communication plans to disseminate results and increase outreach.



Co-benefits

Economic

Strengthened climate governance helps reduce long-term costs linked to climate impacts, limiting reactive spending on recovery from events such as agricultural losses or infrastructure damage caused by drought and seaa-level rise. The funding guide also improves municipalities' access to EU funding by increasing awareness and expertise to apply for funding.

Social

The Andalusian approach places citizen and stakeholder engagement at the centre of resilience building. Cross-sectoral training has improved collaboration across six regional departments, reducing policy silos and fostering a more coordinated approach. Capacity-building efforts have strengthened skills in communication and public engagement, while high-level events have reinforced the role of participatory approaches in adaptation. Together, these actions support the development of more inclusive and widely supported policies.

Environmental

By improving access to funding and project design capacity, the initiative enables the implementation of more environmental adaptation measures, particularly in areas such as water management, agriculture and ecosystem resilience. This creates a multiplier effect, where stronger governance directly supports environmental outcomes.



Replicability – *Who can use this approach and how*

Replicating engagement-focused governance: models, tools and finance pathways

From regional coordination to local implementation

Best suited for

This model of engagement-focused governance is best suited for regions with decentralised governance systems, where local municipalities require targeted support to implement adaptation measures. It is particularly relevant in contexts where cross-sectoral collaboration is needed and where citizens and stakeholders are not yet fully engaged in adaptation planning or decision-making.

Stakeholders' role

The approach is based on a multilevel governance structure. The Andalusian regional government leads the development of practical tools and capacity-building activities, including the funding guide and training programmes. This is supported by the EU Mission on Adaptation to Climate Change, which provides technical expertise, guidance and networking opportunities. Municipalities act as key implementers, using the tools at the local level, while citizens and stakeholders are engaged through dedicated outreach and participation activities.

Built-in scalable tools

The model relies on highly transferable tools and approaches. The funding guide is designed as a replicable instrument, enabling municipalities to identify and access funding opportunities. Similar guides can be developed in other regions with comparable governance structures and climate challenges. In addition, the training formats and engagement strategies are adaptable, allowing replication across different territories, with Andalusia serving as a pilot case demonstrating their effectiveness.

Funding pathways

The technical assistance provided by the Mission Implementation Platform is funded through the EU Mission on Adaptation to Climate Change. Complementary activities, such as public events and awareness campaigns (e.g. Adaptation Day in Granada), are supported through regional and provincial funding sources, illustrating a combination of EU-level support and local financing mechanisms.

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